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HARTSVILLE NUCLEAR PLANTS

VOLUME 1

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INTRODUCTION

TVA is a corporate agency of the United States created by the Tennessee Valley Authority Act of 1933 (48 Stat. 58, as amended, 16 U.S.C. §§ 831-831dd (1970)). In addition to its programs of flood control, navigation, and regional development, TVA operates a power system supplying the power requirements for an area of approximately 80,000 square miles containing about 6.5 million people. Except for direct service by TVA to certain industrial customers and Federal installations with large or unusual power requirements, TVA power is supplied to the ultimate consumer by 160 municipalities and rural electric cooperatives which purchase their power requirements from TVA. TVA is interconnected at 26 points with neighboring utility systems.

The TVA generating system consists of 29 hydro generating plants and 11 Fossil-fueled steam generating plants now in operation. In addition, power from Corps of Engineers' dams in the Cumberland River basin and dams owned by the Aluminum Company of America on Tennessee River tributaries is made available to TVA under long-term contracts.

In the period 1964-1973, peak demands increased 55 percent and energy consumption increased 60 percent. These demands are expected to continue to increase in the future. In order to keep pace with the growing demand, it has been necessary to add substantial capacity to the generating and transmission system on a regular basis. The present system capacity is discussed in section 1.1 of this document.

The Hartsville plant is proposed to satisfy, in part, TVA's obligation to supply an ample amount of electricity to the area which TVA serves. The decision to locate the plant at Hartsville was made after an extensive study of various alternate sites and the relative costs, both environmental and monetary, which would be expected to result from locating a nuclear plant at them.

This environmental report is filed pursuant to AEC regulations in support of TVA's application to construct and operate the plant. A preliminary safety analysis report will also be filed in support of the application. The final safety analysis report will be submitted to AEC at a later date, along with a request for authorization to operate the four units at the designed power level. Under the current schedule, TVA expects to begin to load the nuclear fuel for the first unit in June 1980. Full power operation of the four units is expected in December 1980, June 1981, December 1981, and June 1982, respectively.

It should be noted that, although the four units will begin operation at different times, for impact assessment this environmental report considers all units as operating in order to adequately assess the impact of the project on the environment, and so that consideration of the cumulative effects of the project can be assured.

1.1 Need for Power

The TVA was established to develop the Tennessee River system and to assist in the development of other resources of the Tennessee Valley and adjoining areas. Part of this resource development program is the generation, transmission, and sale of electric power. TVA supplies the electric power needs of an area of 80,000 square miles covering practically all of Tennessee, portions of southwestern Kentucky, northeastern Mississippi, northern Alabama and Georgia, and small sections of North Carolina and Virginia. This supplied area has a total population of about 6.5 million people. TVA provides electric power to three major groups of customers: (1) municipal electric systems and rural electric cooperatives, (2) directly served industries, and (3) directly served Federal agencies. TVA supplies power to 160 municipal and cooperative electric systems which in turn distribute power to more than 2.3 million customers. Included in these municipal systems are cities such as Chattanooga, Huntsville, Knoxville, Memphis, Murfreesboro, Nashville, and Scottsboro; and among the cooperative systems are the Appalachian, North Alabama, and Sand Mountain Electric Cooperatives. Among the 46 industrial companies served directly are ALCOA, Amoco Chemicals Corp., Armour & Co., B.F. Goodrich Co., Consolidated Aluminum Corp., Diamond Alkali Co., General Analine & Film Corp., Monsanto Chemical Co., Olin Mathieson Chemical Corp., Pennsalt Chemicals Corp., Revere Copper and Brass, Inc., Tennessee Corp., Texas Eastern Transmission Corp., and Union Carbide Corp. The Federal agencies served directly by TVA include The Marshall Space Flight Center of NASA at Huntsville, Alabama, the Arnold Engineering Development Center of the Air Force at Tullahoma, Tennessee, and the AEC plants at Oak Ridge and Paducah, Kentucky.

The Federal Power Commission has designated the TVA system as Power Supply Area 20 and lists the major geographical electric load centers on the TVA system as Memphis, Nashville, Columbia, Chattanooga, Knoxville--all in Tennessee--and Paducah, Kentucky, and Huntsville, Alabama.

TVA is a member of the Southeastern Electric Reliability Council (SERC)[a], which was established in January 1970 as one of the nine members of the National Electric Reliability Council (NERC). The purpose of NERC is to encourage improvement in the coordination of bulk electric power systems at both the national and regional levels.

The SERC Region is bordered by other NERC members as follows (see figure 1.1-1): (1) on the northeastern perimeter by the Mid-Atlantic Area Coordination Group (MAAC), (2) on the northern border by the East Central Area Reliability Coordination Agreement (ECAR), (3) on the northwestern corner by the Mid-America Interpool Network (MAIN), and (4) on the western border by the Southwest Power Pool (SPP). The SERC Region is subdivided into the four major groups which make up the total region. These groups are designated as the TVA, the Southern, the Florida, and the Virginia-Carolina (VACAR) subregions. The TVA subregion of SERC consists of the TVA system, the Big Rivers Electric Corporation (Big Rivers EC), and the Henderson Municipal Power and Light Company (Henderson MP&L). The TVA system capacity is approximately 23 times the combined capacity of Big Rivers EC and Henderson MP&L. Due to the size of the TVA system in comparison with the other two systems of the TVA subregion, any subregion or area report of the reliability council is essentially the same as that of the TVA system.

a. The activities of SERC are described in Southeastern Electric Reliability Council, Coordinated Bulk Power Supply Program 1974-1993, April 1974.

Only limited load characteristics and supply data for these two systems are reported in this statement since load estimates and generation planning studies for Big Rivers EC, Henderson MP&L and TVA are not performed jointly.

TVA is not a member of any power pool and therefore the information requested by the AEC Regulatory Guide 4.2 pertaining to power pool is not applicable to TVA.

TVA is interconnected at 26 points with neighboring utility systems. These transmission connections between systems with peak load requirements occurring during different seasons of the year can reduce the reserve capacity that each system must maintain to achieve the necessary level of reliability. These agreements for the interchange of power are called "diversity interchange agreements." TVA, a winter peaking system, has such interchange agreements with these utility groups whose peaks occur in the summer months. In 1965 TVA reached an agreement with Mississippi Power & Light Company for the exchange of power. The diversity interchange agreement with Mississippi Power and Light Company is for 1,500 MWe. In addition, agreements have been reached with the Southern Company for 300 MWe and the Illinois-Missouri Group for 260 MWe of exchange power. This interchange power of 2,060 MWe is considered by TVA to be firm generating capacity during its peak season and is accounted for in that manner in all generation planning studies[a].

1.1.1 Load Characteristics - The TVA peak load in calendar year 1973 occurred on January 12 at 8 a.m. when a demand of 18,888 MWe was met by the system. At the time of this peak load, TVA had 20,586 MWe

a. A detailed description of these arrangements is given in Tennessee Valley Authority X 17-20 (Hartsville) Nuclear Plants, Information Requested by the Attorney General for Antitrust Review, Submitted to AEC February 15, 1974.

of installed generating capacity which included 16,223 MWe of thermal electric power plants and 4,363 MWe of hydroelectric capacity. The load data are shown for the TVA system in Table 1.1-1. Over one-third of the homes in the TVA region are electrically heated, and therefore the energy use for a given period is very weather sensitive. For example, the use shown in Table 1.1-1 for 1971 reflects a very mild winter as compared with the previous year.

Annual peaks grew at a compound rate of 5.0 percent in the 1964-73 period. The predicted growth rate for the 1974-84 period is 5.2 percent. The combined load of two large AEC installations served by TVA declined from 2,784 megawatts at the hour of the peak in 1964 to 1,941 megawatts in 1973. With these large loads excluded, historical TVA system peaks experienced a growth rate of 6.8 percent while the predicted growth rate is 5.8 percent.

Estimates of future electrical loads on the TVA system are prepared by TVA considering numerous factors which may have an impact on future growth, including past load trends. Electrical forecasts are made by type of service category such as residential, commercial, industrial, and Federal agency loads for several geographical regions within the TVA system. Each of these categories is individually examined with consideration given to factors which influence their demand for electricity. For example, residential demand for electricity is based on factors such as population, number of households, customers per household, saturation of appliances, and annual uses of appliances. The other classes of service categories are similarly analyzed to estimate the total demand for electricity on the TVA system.

The apparent large load increase from the annual peak of 1973 to 1974 is due to a large increase expected in the AEC loads served by TVA and from the fact that the peak for calendar year 1973 occurred in January while the peak of calendar year 1974 is expected in December. Thus, there is almost two years of load growth between the two peaks. Table 1.1-2 lists the annual peaks for the TVA subregion. Since load estimates for the three systems are not jointly estimated, the loads shown are the noncoincident peaks. Table 1.1-3 lists the energy requirements for the total subregion.

The load forecast was prepared before the oil embargo and thus does not include the effect of the new aggressive TVA conservation program in this region or growing national public awareness of the importance of conservation. On the other hand, neither did it include the full effect of the substitution of electricity for natural gas and petroleum fuels in business, industry, and homes. The net effect of these two forces is not yet clear, but the substitution effect in the region could exceed the conservation effect through this decade.

While conservation was a consideration in preparing the TVA forecast, conservation programs were not as aggressive then as today. Historically, TVA programs have aimed at the most efficient uses of electricity, which is basically a conservation approach. For example, the programs have emphasized the need to install adequate insulation in buildings, especially homes. Working with TVA, local distributors of TVA power have pressed hard for installation of insulation when serving electrically heated homes. Consequently, the approximately 800,000 electrically heated homes built in the TVA area in approximately the last 25 years are rather well insulated relative to homes heated by other

sources. An intense effort was initiated in 1971 to further promote the use of insulation in all building construction in the Tennessee Valley. TVA submitted proposed insulation standards which are now being considered for enactment into law by the Tennessee legislature (Senate Bill No. 1687). Before the oil embargo, the conservation program emphasized prudent, efficient use of electricity. Present programs emphasize reducing electrical usage while continuing to stress efficient use. While the conservation effect was reflected in the load forecasts, much of the effect is expected to be offset by faster customer growth due to the post-war baby boom, growing usage for pollution control, and the shortage of alternative fuels.

TVA's interruptible load under contract is utilized as an operating reserve (interruptible on 5-minute notice). The purpose of this type of interruptible load is to provide operating flexibility at the time of the system peak to cover contingencies such as sudden large demand increases resulting from corresponding change in temperature at the time of the system peak and for offsetting the effects of loss of spinning reserve as a result of an instantaneous loss of a large unit.

TVA has three basic types of interruptible power under contracts with large industrial customers served directly by TVA. The types are 2 percent, 2.5 percent, and 3 percent interruptible power. TVA has the right to curtail power 2, 2.5, and 3 percent of the time during the respective 10-year contract periods. As of July 1, 1974,

TVA had under contract 254,800 kW of 2-percent interruptible power, 449,500 kW of 2.5-percent interruptible power, and 275,000 kW of 3-percent interruptible power.

Generation planning by TVA is based on the system's peak load requirements which occur during the winter months. The 2,060 megawatts which TVA and the surrounding utilities exchange on a seasonal basis is considered by TVA to be firm generating capacity during its peak season, thereby saving this amount of installed capacity.

Table 1.1-4 lists the power and energy exchanges between TVA and the other utilities. The energy deliveries reflect the total diversity interchange as well as purchases and sales.

Monthly peak and energy loads for the initial full year of operation of the Hartsville Plant are shown in table 1.1-5 for the TVA system and in table 1.1-6 for the subregion. Interruptible loads in this period are contingent upon contract renewals and the sale of additional interruptible load for this period. An estimate has not been made. TVA has no power purchases or sales contracts in addition to the diversity interchange agreements discussed previously.

Figure 1.1-2 shows an estimated annual load duration curve for the first year of plant operation which is based on historical data. TVA's capacity planning studies show that base load nuclear generation is the most economical form of generation to add in this time period. Adding base-load generation has significant environmental and economic advantages over adding peaking plants to the system because the base load alternative results in much less operation of TVA's older, less efficient, more costly fossil units. Therefore, as indicated in table 1.1-7, some of the existing coal-fired units are expected to serve primarily in the role of intermediate operation in

the mid-1980 period. The extent that these coal-fired units will be used as base load during this period will be governed by future systems need, fuel costs, fuel availability, etc.

<u>1.1.2 Power Supply</u> - TVA's generating capacity planning is based on probability techniques according to the current state-of-the-art. The techniques (see Section 1.1.3) are used to determine the generating capacity required to supply the load requirements plus reserves with a system reliability in terms of the number of days per year that the system load may be expected to exceed the available generating capacity.

System reliability is dependent upon many factors such as the reliability of the many generating sources making up the system and the multiplicity of components associated with each generating source. TVA plans for generating capacity additions to provide the reliability of bulk power supply in accordance with a probability risk commonly termed the index of reliability. TVA, along with most other utilities, uses an index of one day in ten years. This means that one day in ten years (0.1 day per year) the system load can be expected to exceed the available generating capability.

Therefore, TVA's generating capacity planning criteria is to provide a reasonable assurance that sufficient capacity will be available at the time of the system peaks such that the probability of risk will not exceed the acceptable index of reliability.

TVA's power generating facilities in service on January 1, 1974, included 29 hydro plants, 12 steam plants (including the Allen Steam Plant leased from Memphis), and 2 gas turbine installations. Twelve hydro plants owned by subsidiaries of the Aluminum Company of America and 8 hydro plants of the United States Army Corps of Engineers are

operated in coordination with the TVA system. Most of the power from the plants of the Corps of Engineers is supplied to TVA at points of generation. All of the power from the plants of the ALCOA subsidiaries is supplied to TVA at the points of generation under contractual arrangements pursuant to which TVA supplies the power requirements both of ALCOA and of an ALCOA subsidiary which operates a distribution system in western North Carolina.

Table 1.1-7 shows the TVA system capabilities (including ALCOA subsidiaries and U.S. Corps of Engineers) as of January 1, 1969, (5 years before filing of the Hartsville Environmental Report). Table 1.1-8 shows the changes in system capacity for the period January 1, 1969, to January 1, 1974. Table 1.1-9 shows future unit additions to the TVA system for the 1974-84 period. No plans have been finalized for the additional generating units beyond the Hartsville units. Tables 1.1-10 and 1.1-11 show capacity data for the subregion.

1.1.3 Capacity Requirements

1.1.3.1 Method and Criterion Employed to Determine the Minimum System Reserve Criterion - TVA uses the "loss of load" method as a means to determine generating capacity to supply load requirements plus reserves. The method, a probability technique, is well documented in the literature[a] and is widely used throughout the electric utility industry for capacity planning.

TVA's generation planning criterion and method determines the amount of capacity required to provide a reasonable assurance that

a. See, for example, Application of Probability Methods to Generating Capacity Problems, AIEE Transactions, pf. III (Power Apparatus and Systems), Vol. 79, 1960, pp. 1165-82.

sufficient capacity will be available at the time of future system peaks so that the probability of risk will not be greater than the acceptable index of reliability (0.1 day per year) for a reliable supply of bulk power.

Capacity models are developed from the unit capabilities as shown in Tables 1.1-7, 1.1-8, and 1.1-9. At the same time the load model is developed from the forecast load and load characteristics specified in Section 1.1.1, Load Characteristics.

For existing fossil-fired units with capacities less than 500 MW, TVA used the following forced outage rates in its generation planning studies:

Unit Size (MW)	Outage Rates (%)
50 - 125	5.0
126 - 130	4.3
131 - 140	3.7
141 - 154	5.1
155 - 175	
4 units	4.2
10 units	1.7
176 - 200	1.9
201 - 225	
4 units	2.8
5 units	4.0
226 - 290	6.4
291 - 300	4.1

These outage rates are based on TVA's operating experience.

Beginning in 1961, fossil-fired steam electric units 500 MW and larger were installed on the TVA system to take advantage of the economics of scale of large units, recognizing the probabilities of larger forced outage rates. Based on TVA's experience to date, TVA uses a planning forced outage rate of 13 percent for fossil-fired units greater than 500 MW. Edison Electric Institute's 1972 "Report on Equipment Availability for the Twelve-Year Period 1960-71" indicates forced outage rates of 16-17 percent for units larger than 600 MW. TVA uses an estimated 10-percent forced outage rate for nuclear units and a planning forced outage rate of 5 percent for pumped storage and combustion turbines.

Generation planning on the TVA system is made on a month-by-month basis and is based on the expectation that no maintenance will be scheduled during the winter and summer peak months of January and August, respectively. For present TVA system characteristics, planning sufficient capacity to meet the load plus reserve requirements for the peak months at the same time provides load plus reserve requirements with sufficient margin to perform maintenance in the offpeak months. Seasonal capacity exchange under contract is reflected in TVA planning studies as an adjustment to the system load model. The reserve requirements for the exchanged capacity are provided for by the supplying system.

<u>1.1.3.2 Effect of Operation of the Proposed Nuclear Units on the TVA System</u> - The TVA power system is a winter and summer peaking system with the highest annual peak loads in the TVA area occurring between November and March. Due to seasonal exchange arrangements with other power systems, however, the summer and winter peak loads which the TVA generating capacity must actually serve are

not significantly different for this time period. The following tabulations indicate TVA's expected power supply outlook during the 1981-82 peak load seasons based on the current capacity installation schedules.

Period	Estimated Peak Demand TVA System MW	Interchange Delivered (Received) MW	Load Served by TVA-MW	Dependable Capacity MW
Winter 1980-81	30,900	-2,060	28,840	34,403
Summer 1981	27,050	+2,060	29,110	35,774
Winter 1981-82	32,650	-2,060	30,590	36,803
Summer 1982	28,390	+2,060	30,450	38,174

	Margins				
Period	Desired MW	Desired %	Available MW	Available %	Surplus (Deficiency) MW
Winter 1980-81	7,306	25.3	5,563	19.3	-1,743
Summer 1981	6,636	22.8	6,664	22.9	28
Winter 1981-82	7,758	25.4	6,213	20.3	-1,545
Summer 1982	6,927	22.7	7,724	25.4	797

The above power supply projection is based on assuming commercial operating dates of the proposed Hartsville Nuclear Plant units of December 1980, June 1981, December 1981, and June 1982. If the interchange deliveries were not available during this period, TVA would need to install at least two additional generating units the size of the Hartsville units.

<u>1.1.4 Statement on Area Need</u> - Due to the size of the TVA system in comparison to the subregion, any report on the area requirements or reliability is essentially the same as that of the TVA system.

TABLE 1.1-1

TVA SYSTEM NET ANNUAL PEAKS
AND ENERGY REQUIREMENTS

C.Y.	TVA Area Net Peak - MW Date	Hour	MW	Energy - Million kWh TVA Area Net Requirements
			Actual	
1964	1-15	8a	12,157	71,300
1965	2-3	8a	12,801	77,710
1966	1-31	9a	14,263	83,200
1967	2-25	9a	14,634	85,429
1968	1-8	8a	15,266	88,800
1969	1-10	8a	15,017	93,190
1970	1-21	9a	16,797	94,978
1971	2-10	8a	16,745	94,109
1972	12-18	9a	17,465	103,096
1973	1-12	8a	18,888	111,978
			Projected	
1974	12		21,840	128,100
1975	12		22,860	136,610
1976	12		24,260	143,720
1977	12		25,440	149,850
1978	12		26,780	156,960
1979	12		28,200	164,400
1980	12		29,720	172,850
1981	12		31,350	180,780
1982	12		32,950	189,420
1983	12		34,580	197,920
1984	12		36,200	207,060

TABLE 1.1-2

TVA SUBREGIONAL NET ANNUAL PEAKS

	TVA Area Net Peak - MW			Henderson MP&L	Big Rivers EC	
C.Y.	Date	Hour	MW	Net Peak - MW	Net Peak - MW	Total
			Actual			
1964	1-15	8a	12,157	19	-	12,176
1965	2-3	8a	12,801	19	-	12,820
1966	1-31	9a	14,263	23	50	14,336
1967	2-25	9a	14,634	25	67	14,726
1968	1-8	8a	15,266	30	94	15,390
1969	1-10	8a	15,017	32	92	15,141
1970	1-21	9a	16,797	22	151	16,970
1971	2-10	8a	16,745	352		17,097
1972	12-18	9a	17,465	40	508	18,013
1973	1-12	8a	18,888	44	722	19,654
			Projected			
1974	12		21,840	774		22,614
1975	12		22,860	785		23,645
1976	12		24,260	798		25,058
1977	12		25,440	910		26,350
1978	12		26,780	925		27,705
1979	12		28,200	941		29,141
1980	12		29,720	958		30,678
1981	12		31,350	976		32,326
1982	12		32,950	996		33,946
1983	12		34,580	1,017		35,597
1984	12		36,200	1,038		37,238

TABLE 1.1-3

TVA SUBREGIONAL NET ENERGY REQUIREMENTS

Millions kWh

C.Y.	TVA Area	Henderson MP&L	Big Rivers EC	Total
		Actual		
1964	71,300	72	-	71,372
1965	77,710	77	-	77,787
1966	83,200	91	253	83,544
1967	85,429	94	348	85,871
1968	88,800	111	447	89,358
1969	93,190	125	617	93,932
1970	94,978	136	1,723	96,837
1971	94,109	143	2,828	97,080
1972	103,096	161	3,844	107,101
1973	111,978	179	5,063	117,220
		Projected		
1974	128,100	6,091		134,191
1975	136,610	6,147		142,757
1976	143,720	6,222		149,942
1977	149,850	7,031		156,881
1978	156,960	7,306		164,266
1979	164,400	7,382		171,782
1980	172,850	7,465		180,315
1981	180,780	7,550		188,330
1982	189,420	7,646		197,066
1983	197,920	7,743		205,663
1984	207,060	7,840		214,900

TABLE 1.1-4

POWER AND ENERGY DELIVERIES

C.Y.	Interchange Capacity Available[1/] To TVA	Interchange Capacity Available[1/] From TVA	Energy Deliveries[2/] Millions of kWh To TVA	Energy Deliveries[2/] Millions of kWh From TVA
		Actual		
1964	0	0	-	323
1965	0	0	68	772
1966	0	0	428	1,708
1967	0	0	1,138	2,471
1968	1,250	150	1,985	2,746
1969	1,800	150	2,415	3,575
1970	1,800	0	2,335	3,732
1971	1,845	200	2,570	2,707
1972	2,360	0	3,128	2,703
1973	2,360	0	3,835	2,799
		Projected		
1974	2,160	0	4,114	2,799
1975	2,160	0	3,202	2,799
1976	2,060	0	2,799	2,799
1977	2,060	0	2,799	2,799
1978	2,060	0	2,799	2,799
1979	2,060	0	2,799	2,799
1980	2,060	0	2,799	2,799
1981	2,060	0	2,799	2,799
1982	2,060	0	2,799	2,799
1983	2,060	0	2,799	2,799
1984	2,060	0	2,799	2,799

[1/] Data for the period 1964-73 were reported on FPC Form 12E as capacity available from sales and seasonal capacity exchange and firm obligations to other systems at time of annual peak demand.

[2/] Total calendar year annual energy.

TABLE 1.1-5

TVA SYSTEM MONTHLY PEAK AND ENERGY LOAD FOR
INITIAL TWELVE MONTHS OF OPERATION OF
HARTSVILLE PLANT

Month	Year	TVA Net Peak - MW	TVA Net Energy Millions kWh
June	1982	27,300	15,320
July	1982	28,330	16,490
Aug.	1982	28,390	16,400
Sept.	1982	27,270	15,270
Oct.	1982	26,770	14,240
Nov.	1982	30,480	15,280
Dec.	1982	32,950	17,450
Jan.	1983	34,350	18,850
Feb.	1983	32,980	17,860
March	1983	31,400	16,260
April	1983	27,970	15,130
May	1983	26,170	14,570

TABLE 1.1-6

TVA SUBREGION MONTHLY PEAK AND ENERGY LOAD FOR INITIAL TWELVE MONTHS OF OPERATION OF HARTSVILLE PLANT

Month	Year	TVA Subregion Net Peak - MW	TVA Subregion Net Energy Millions kWh
June	1982	28,278	15,940
July	1982	29,323	17,138
Aug.	1982	29,398	17,055
Sept.	1982	28,269	15,904
Oct.	1982	27,753	14,894
Nov.	1982	31,462	15,914
Dec.	1982	33,946	18,119
Jan.	1983	35,346	19,514
Feb.	1983	33,970	18,451
March	1983	32,383	16,907
April	1983	28,948	15,751
May	1983	27,159	15,219

TABLE 1.1-7

TVA Generating Capability

As of January 1, 1969

TVA Fossil-Fired Steam Units

Plant	Unit	Function	Net Generator Capability - kW Unit	Net Generator Capability - kW Plant
Allen	No. 1	Base, Intermediate	296,000	
	No. 2	Base, Intermediate	296,000	
	No. 3	Base, Intermediate	296,000	
				888,000
Bull Run	No. 1	Base, Intermediate	905,000	905,000
Colbert	No. 1	Base, Intermediate	200,000	
	No. 2	Base, Intermediate	200,000	
	No. 3	Base, Intermediate	200,000	
	No. 4	Base, Intermediate	200,000	
	No. 5	Base	505,000	
				1,305,000
Gallatin	No. 1	Base	262,000	
	No. 2	Base	262,000	
	No. 3	Base	285,000	
	No. 4	Base	285,000	
				1,094,000
John Sevier	No. 1	Base, Intermediate	210,000	
	No. 2	Base, Intermediate	210,000	
	No. 3	Base, Intermediate	210,000	
	No. 4	Base, Intermediate	210,000	
				840,000
Johnsonville	No. 1	Base, Intermediate	132,000	
	No. 2	Base, Intermediate	132,000	
	No. 3	Base, Intermediate	132,000	
	No. 4	Base, Intermediate	132,000	
	No. 5	Base, Intermediate	132,000	
	No. 6	Base, Intermediate	132,000	
	No. 7	Base, Intermediate	152,000	
	No. 8	Base, Intermediate	152,000	
	No. 9	Base, Intermediate	152,000	
	No.10	Base, Intermediate	152,000	
				1,400,000
Kingston	No. 1	Base, Intermediate	155,000	
	No. 2	Base, Intermediate	155,000	
	No. 3	Base, Intermediate	155,000	
	No. 4	Base, Intermediate	155,000	
	No. 5	Base, Intermediate	210,000	
	No. 6	Base, Intermediate	210,000	
	No. 7	Base, Intermediate	210,000	
	No. 8	Base, Intermediate	210,000	
	No. 9	Base, Intermediate	210,000	
				1,670,000

TABLE 1.1-7 (cont'd.)

TVA Generating Capability

As of January 1, 1969

TVA Fossil-Fired Steam Units, (Cont'd.)

Plant	Unit	Function	Net Generator Capability - kW Unit	Plant
Paradise	No. 1	Base	715,000	
	No. 2	Base	715,000	
				1,430,000
Shawnee	No. 1	Base	155,000	
	No. 2	Base	155,000	
	No. 3	Base	155,000	
	No. 4	Base	155,000	
	No. 5	Base	155,000	
	No. 6	Base	155,000	
	No. 7	Base	1 5,000	
	No. 8	Base	155,000	
	No. 9	Base	155,000	
	No.10	Base	155,000	
				1,550,000
Watts Bar	No. A	Peaking	61,000	
	No. B	Peaking	61,000	
	No. C	Peaking	61,000	
	No. D	Peaking	61,000	
				244,000
Widows Creek	No. 1	Base, Intermediate	129,000	
	No. 2	Base, Intermediate	129,000	
	No. 3	Base, Intermediate	129,000	
	No. 4	Base, Intermediate	129,000	
	No. 5	Base, Intermediate	129,000	
	No. 6	Base, Intermediate	129,000	
	No. 7	Base	549,000	
	No. 8	Base	549,000	
				1,872,000
SUBTOTAL - TVA Fossil Plants				13,198,000

TVA Hydro Units - Base Load and Peaking

Apalachia	No. 1		36,000	
	No. 2		36,000	
				72,000
Blue Ridge	No. 1		2,000	2,000
Boone	No. 1		18,000	
	No. 2		18,000	
	No. 3		18,000	
				54,000
Chatuge	No. 1		5,000	5,000
Cherokee	No. 1		18,750	
	No. 2		18,750	
	No. 3		18,750	
	No. 4		18,750	
				75,000

TABLE 1.1-7 (Cont'd.)

TVA Generating Capability

As of January 1, 1969

TVA Hydro Units - Base Load and Peaking, (Cont'd.)

Plant	Unit	Net Generator Capability - kW Unit	Net Generator Capability - kW Plant
Chickamauga	No. 1	31,000	
	No. 2	31,000	
	No. 3	31,000	
	No. 4	31,000	
			124,000
Douglas	No. 1	17,000	
	No. 2	12,000	
	No. 3	17,000	
	No. 4	12,000	
			58,000
Fontana	No. 1	52,000	
	No. 2	58,000	
	No. 3	62,000	
			172,000
Fort Loudoun	No. 1	34,000	
	No. 2	36,000	
	No. 3	34,000	
	No. 4	36,000	
			140,000
Fort Patrick Henry	No. 1	18,000	
	No. 2	18,000	
			36,000
Great Falls	No. 1	10,000	
	No. 2	11,000	
			21,000
Guntersville	No. 1	27,000	
	No. 2	27,000	
	No. 3	27,000	
	No. 4	27,000	
			108,000
Hiwassee	No. 1	47,000	
	No. 2	48,000	
			95,000
Kentucky	No. 1	37,000	
	No. 2	32,000	
	No. 3	32,000	
	No. 4	37,000	
	No. 5	37,000	
			175,000
Melton Hill	No. 1	37,500	
	No. 2	37,500	
			75,000

TABLE 1.1-7 (Cont'd.)

TVA Generating Capability

As of January 1, 1969

TVA Hydro Units - Base Load and Peaking, (Cont'd.)

Plant	Unit	Net Generator Capability - kW Unit	Net Generator Capability - kW Plant
Nickajack	No. 1	24,000	
	No. 2	24,000	
	No. 3	24,000	
	No. 4	24,000	
			96,000
Nolichucky	No. 1	2,000	
	No. 2	2,000	
	No. 3	4,000	
	No. 4	4,000	
			12,000
Norris	No. 1	28,500	
	No. 2	28,500	
			57,000
Nottely	No. 1	9,000	9,000
Ocoee I	No. 1	4,400	
	No. 2	4,400	
	No. 3	4,400	
	No. 4	4,400	
	No. 5	4,400	
			22,000
Ocoee II	No. 1	9,000	
	No. 2	9,000	
			18,000
Ocoee III	No. 1	27,000	27,000
Pickwick	No. 1	37,400	
	No. 2	37,400	
	No. 3	41,000	
	No. 4	37,400	
	No. 5	37,400	
	No. 6	37,400	
			228,000
South Holston	No. 1	22,000	22,000
Watauga	No. 1	19,000	
	No. 2	19,000	
			38,000
Watts Bar	No. 1	35,000	
	No. 2	35,000	
	No. 3	35,000	
	No. 4	35,000	
	No. 5	35,000	
			175,000

TABLE 1.1-7 (Cont'd.)

TVA Generating Capability

As of January 1, 1969

TVA Hydro Units - Base Load and Peaking, (Cont'd.)

Plant	Unit	Net Generator Capability - kW Unit	Net Generator Capability - kW Plant
Wheeler	No. 1	33,090	
	No. 2	33,090	
	No. 3	33,090	
	No. 4	33,090	
	No. 5	33,090	
	No. 6	33,090	
	No. 7	33,090	
	No. 8	33,090	
	No. 9	33,090	
	No.10	33,090	
	No.11	33,100	
			364,000
Wilbur	No. 1	1,300	
	No. 2	1,300	
	No. 3	1,250	
	No. 4	7,150	
			11,000
Wilson	No. 1	23,000	
	No. 2	23,000	
	No. 3	23,000	
	No. 4	23,000	
	No. 5	31,000	
	No. 6	31,000	
	No. 7	31,000	
	No. 8	31,000	
	No. 9	25,000	
	No.10	25,000	
	No.11	25,000	
	No.12	25,000	
	No.13	25,000	
	No.14	25,000	
	No.15	25,000	
	No.16	25,000	
	No.17	25,000	
	No.18	26,000	
	No.19	54,000	
	No.20	54,000	
	No.21	54,000	
			629,000
SUBTOTAL - TVA Hydro			2,920,000

TABLE 1.1-7 (Cont'd.)

TVA Generating Capability

As of January 1, 1969

Tapoco, Inc., Hydro Units - Base Load and Peaking

Plant	Unit	Net Generator Capacity - kW Unit	Plant
Calderwood	No. 1	38,000	
	No. 2	38,000	
	No. 3	38,000	
			114,000
Cheoah	No. 1	20,000	
	No. 2	20,000	
	No. 3	20,000	
	No. 4	20,000	
	No. 5	30,000	
			110,000
Chilhowee	No. 1	17,660	
	No. 2	17,670	
	No. 3	17,670	
			53,000
Santeetlah	No. 1	19,500	
	No. 2	19,500	
			39,000
SUBTOTAL - Tapoco, Inc., Hydro			316,000

Nantahala Power and Light - Hydro Units - Base Load and Peaking

Bear Creek	No. 1	9,000	9,000
Cedar Cliff	No. 1	7,000	9,000
Nantahala	No. 1	39,000	39,000
Tennessee Creek	No. 1	9,000	9,000
Thorpe	No. 1	22,000	22,000
Minor Plants			3,000
SUBTOTAL - Nantahala Power & Light Hydro			89,000

Corps of Engineers Hydro Units - Base Load and Peaking

Barkley	No. 1	20,000	
	No. 2	20,000	
	No. 3	20,000	
	No. 4	20,000	
			80,000
Center Hill	No. 1	39,000	
	No. 2	39,000	
	No. 3	39,000	
			117,000

TABLE 1.1-7, (Cont'd.)

TVA Generating Capability

As of January 1, 1969

Corps of Engineers Hydro Units - Base Load and Peaking, (Cont'd.)

Cheatham	No. 1	8,660	
	No. 2	8,670	
	No. 3	8,670	
			26,000
Dale Hollow	No. 1	15,660	
	No. 2	15,670	
	No. 3	15,670	
			47,000
Old Hickory	No. 1	24,250	
	No. 2	24,250	
	No. 3	24,250	
	No. 4	24,250	
			97,000
Wolf Creek	No. 1	34,000	
	No. 2	34,000	
	No. 3	34,000	
	No. 4	34,000	
	No. 5	34,000	
	No. 6	34,000	
			204,000
SUBTOTAL - Corps of Engineers Hydro			571,000
TOTAL - TVA System - January 1, 1969			17,094,000

TABLE 1.1-8

TVA SYSTEM UNIT ADDITIONS, RETIREMENTS, DERATINGS, AND UPRATINGS FOR THE PERIOD JANUARY 1, 1969 - JANUARY 1, 1974

Date	Plant	Unit	Type	System	Net Generator Capability - kW	Function
Feb. 1970	Paradise	3	Fossil	TVA (addition)	1,040,000	Base Load
Feb. 1970	Percy Priest	1	Hydro	CE (addition)	33,000	Base Load & Peaking
Jun. 1971	Allen	1-16	GT	TVA (addition)	419,200	Peaking & Intermediate
Mar. 1972	Tims Ford	1	Hydro	TVA (addition)	40,000	Base Load & Peaking
Aug. 1972	Nolichucky	1-4	Hydro	TVA (retire)	12,000	Base Load & Peaking
Sep. 1972	Allen	17-20	GT	TVA (addition)	294,800	Peaking
Sep. 1972	Colbert	1-8	GT	TVA (addition)	589,600	Peaking
Mar. 1973	Cumberland	1	Fossil	TVA (addition)	1,158,000	Base Load
Aug. 1973	Cordell Hull	1	Hydro	CE (addition)	33,000	Base Load & Peaking
Oct. 1973	Cordell Hull	2	Hydro	CE (addition)	33,000	Base Load & Peaking
Nov. 1973	Cumberland	2	Fossil	TVA (addition)	1,158,000	Base Load
Dec. 1973	Allen	1-3	Fossil	TVA (derating)	9,000	Base Load & Intermediate
Dec. 1973	Colbert	1-4	Fossil	TVA (derating)	8,000	Base Load & Intermediate
Dec. 1973	Gallatin	3-4	Fossil	TVA (derating)	4,000	Base Load
Dec. 1973	John Sevier	1-4	Fossil	TVA (derating)	8,000	Base Load & Intermediate
Dec. 1973	Johnsonville	1-10	Fossil	TVA (derating)	16,000	Base Load & Intermediate
Dec. 1973	Kingston	1-9	Fossil	TVA (derating)	63,000	Base Load & Intermediate
Dec. 1973	Paradise	1-3	Fossil	TVA (uprating)	23,000	Base Load
Dec. 1973	Shawnee	1-10	Fossil	TVA (derating)	10,000	Base Load
Dec. 1973	Watts Bar	1-4	Fossil	TVA (derating)	16,000	Peaking
Dec. 1973	Widows Creek	1-8	Fossil	TVA (derating	10,000	Base Load & Intermediate
Dec. 1973	Colbert	1-8	GT	TVA (derating)	48,000	Peaking
TOTALS - January 1, 1974				TVA System	21,711,600	

Table 1.1-9

TVA SYSTEM UNIT ADDITIONS
COMMERCIAL OPERATION AFTER JANUARY 1, 1974

Date	Plant	Unit	Type	Capability-kW	Function
February 1974	Cordell Hull (Corps of Engineers)	3	Hydro	34,000	Base Load & Peaking
(In Initial Operation)	Browns Ferry	1	Nuclear	1,065,000	Base Load
October 1974	Browns Ferry	2	Nuclear	1,065,000	Base Load
May 1975	Raccoon Mountain	1	Pumped Storage	325,000	Peaking
July 1975	Raccoon Mountain	2	Pumped Storage	325,000	Peaking
Summer 1975	Gas Turbine Installation	-	Gas Turbines	600,000	Peaking
September 1975	Raccoon Mountain	3	Pumped Storage	325,000	Peaking
September 1975	Browns Ferry	3	Nuclear	1,065,000	Base Load
November 1975	Raccoon Mountain	4	Pumped Storage	325,000	Peaking
August 1976	Sequoyah	1	Nuclear	1,125,000	Base Load
April 1977	Sequoyah	2	Nuclear	1,125,000	Base Load
November 1978	Watts Bar Nuclear	1	Nuclear	1,170,000	Base Load
August 1979	Watts Bar Nuclear	2	Nuclear	1,170,000	Base Load
December 1979	Bellefonte	1	Nuclear	1,170,000	Base Load
September 1980	Bellefonte	2	Nuclear	1,170,000	Base Load
Fall 1980	Hartsville Plant A	1	Nuclear	1,170,000	Base Load
Spring 1981	Hartsville Plant B	1	Nuclear	1,170,000	Base Load
Fall 1981	Hartsville Plant A	2	Nuclear	1,170,000	Base Load
Spring 1982	Hartsville Plant B	2	Nuclear	1,170,000	Base Load
Fall 1982	Undetermined	-	*	1,200,000	Base Load
Spring 1983	Undetermined	-	*	1,200,000	Base Load
Fall 1983	Undetermined	-	*	1,200,000	Base Load
Spring 1984	Undetermined	-	*	1,200,000	Base Load
Fall 1984	Undetermined	-	*	1,200,000	Base Load

*Preliminary--no contracts awarded.

TABLE 1.1-10

SUBREGION GENERATING CAPABILITY
AS OF JANUARY 1, 1969

Plant	Unit	Net Generator Capability-kW Unit	Net Generator Capability-kW Plant
Big Rivers RECC Fossil-Fired Steam Units - Base Load			
Reid	No. 1	80,000	80,000
SUBTOTAL - Big Rivers Fossil Steam as of January 1, 1969			80,000
Henderson MP&L Fossil-Fired Steam Units - Base Load			
Station 1	No. 1	1,000	
	No. 2	1,000	
	No. 3	5,000	
	No. 4	5,000	
	No. 5	11,000	
	No. 6	25,000	48,000
SUBTOTAL - Henderson Fossil Steam as of January 1, 1969			48,000
Nantahala (not included as a part of the TVA system)			3,000
TVA System (as of January 1, 1969)			17,094,000
SUBREGION TOTAL (As of January 1, 1969)			17,225,000

TABLE 1.1-11

UNIT ADDITIONS TO SUBREGION
BESIDES THE TVA ADDITIONS

Date	Plant	Unit	Type	System	Net Generator Capability (kW)	Function
		Installed				
Sept. 1969	Coleman	1	Fossil	Big Rivers (addition)	165,000	Base load
July 1970	Coleman	2	Fossil	Big Rivers (addition)	165,000	Base load
Dec. 1971	Coleman	3	Fossil	Big Rivers (addition)	155,000	Base load
Spring 1973	Station 2	1	Fossil	Henderson (addition)	175,000	Base load
Fall 1973	Station 2	2	Fossil	Henderson (addition)	175,000	Base load
Dec. 1973	Coleman	3	Fossil	Big Rivers (uprating)	10,000	Base load
		Planned				
Fall 1978	--	--	Fossil	Big Rivers (addition)	175,000	Base load
Fall 1983	--	--	Fossil	Big Rivers (addition)	250,000	Base load

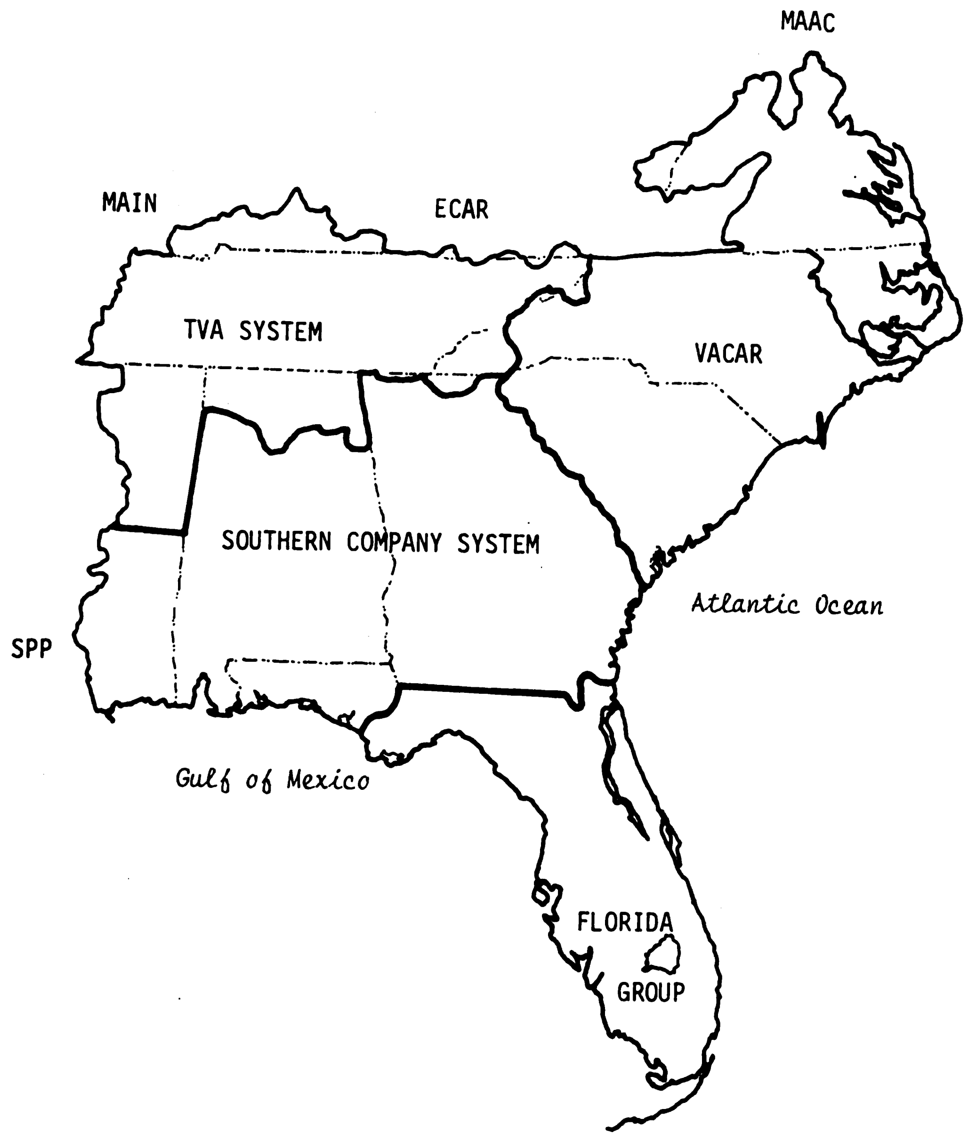

Figure 1.1-1

SOUTHEASTERN ELECTRIC RELIABILITY COUNCIL REGION

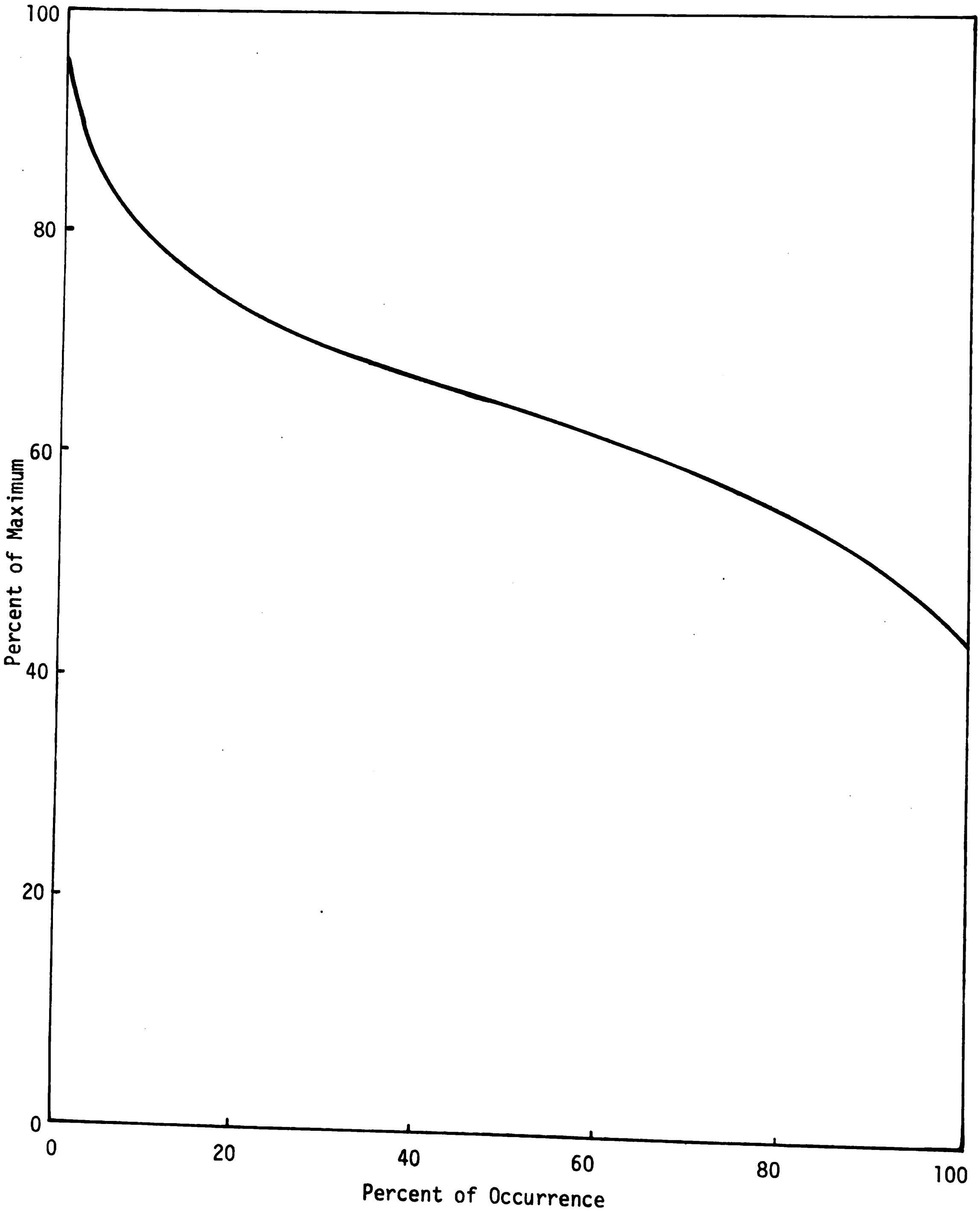

Figure 1.1-2
EXPECTED ANNUAL LOAD DURATION CURVE
FOR INITIAL FULL YEAR OF OPERATION
OF HARTSVILLE PLANT

1.2 Other Objectives

TVA has no plans for objectives to be met by this project other than those described herein.

1.3 Consequences of Unit Delays

Based on current projections, the power supply situation for the period during which the Hartsville units are scheduled to become commercial is expected to be extremely tight, even if the current projected schedules of capacity additions are achieved. Any delay in operation of the Hartsville units could result in the inability of the TVA system to adequately meet its load obligations and jeopardize the reliability of TVA's bulk power supply.

The following tabulation indicates the amounts by which reserves on the TVA system will be inadequate during the peak load seasons, postulating a delay of 6 months and 12 months for each of the Hartsville units (a delay in unit 1 results in an equal delay in the other units):

Period	Megawatt Deficiencies in TVA System Reserve Due to Unit Delays of:	
	6 Months	12 Months
Winter 1980-81	2,904	2,904
Summer 1981	1,147	2,314
Winter 1981-82	2,713	3,876
Summer 1982	387	1,566
Winter 1982-83	1,271	2,448

Any Hartsville unit delays would result in a serious deficiency in margins available for scheduled maintenance for all TVA generating units during the period of delay.

Deficiencies of the magnitude caused by delays of the Hartsville units must be replaced either by installing alternative capacity on the

TVA system or importing power from other utility systems; otherwise, the reliability of power supply to TVA's customers will be drastically reduced. By the time delays in the Hartsville nuclear units would be confirmed, it is unlikely that additional capacity other than short lead-time generating capacity could be installed to meet these deficiencies. Power in the magnitude being considered is not expected to be available from other utilities when it would be needed on the TVA system.

The economic costs of any Hartsville delays (which must ultimately be borne by the consumer) would consist of two parts: (1) cost of replacement capacity, and (2) increased production expense during the delay period because of unavailability of low-cost base-load nuclear energy.

As a measure of the cost of replacement capacity, the estimated investment cost of 1,000 MW of replacement capacity which could be installed for the 1980-82 period is approximately $150 million (based on 1980 dollars). Annual fixed charges of about $15 million on such an investment must be borne by consumers in the form of higher rates until the effect of these additions can be absorbed in later years by system growth. The value of these fixed charges (8-percent discount rate and a discount period of 4 years) would be about $50 million.

Fuel, operating, and maintenance expense for the Hartsville nuclear units is estimated to cost about 3 mills per kWh during the 1980-82 period, while replacement energy which would be used in lieu of this nuclear energy in the event of delays would cost from 8 to 28 mills per kWh, depending on the source of this replacement energy. Studies of the effects of Hartsville unit delays indicate that each month's

delay of these units would result in increased production expenses on the TVA system. The magnitude of the increase in production expense would depend on the length of the delays. As a result of a 6-month delay the TVA power system would be reduced by the capacity of one unit for each month in the period--December 1980 to December 1982. If each unit is delayed 12 months from the current schedule, TVA would be without the capacity of one unit for two 6-month periods and two units for three 6-month periods. In months where TVA is without one unit the production expenses would increase by approximately $4 million per month, and approximately 300,000 tons of additional coal and approximately 3.3 million gallons of oil would be consumed.

In summary, delays of the Hartsville Nuclear Plant will have a twofold effect on the TVA power system: (1) Costs to TVA's customers would be increased by at least $4 million for each month of delay of one unit, assuming the delay did not require the installation of combustion turbines or combined-cycle units. If additional generating capacity were required to offset deficiencies due to Hartsville delays, costs to TVA's consumers over and above those shown above could be increased by $50 million. These costs could total about $98 million for a 12-month delay; and (2) increased operation of TVA's older, less efficient fossil-fired units would be required during the period of further Hartsville delays. Such operation would result in the increased emission of particulates, sulfur dioxide, and other materials into the atmosphere.

The analysis shown in Section 1.1.3.2 shows that TVA cannot carry out its statutory obligation of providing an ample supply of electricity

for the TVA region without constructing and operating the generating capacity which will be provided by the Hartsville Nuclear Plant. Even with the Hartsville plant the reliability risk level will be below that which TVA considers desirable during the winters of 1980-81 and 1981-82.

2.1 Site Location and Layout

The Hartsville site is located in north central Tennessee in Smith and Trousdale counties, approximately 40 miles northeast of Nashville. The nearest communities are Hartsville which is about 5 miles west of the site and Dixon Springs which is about 1-1/2 miles east of the site. Figure 2.1-1 shows the regional location of the plant site and population maps are given in Section 2.2. The site is located on the Cumberland River at approximate river mile 285. The site topography is generally low rolling hills with bottom lands along the Cumberland River and the creeks. Site elevation ranges from 460 above MSL near the river to approximately 800 feet above MSL in the north and northwest portions of the site. Figure 2.1-2 presents general topographic features of the site and surrounding area. Figure 2.1-3 shows the roads in the area, both state highways and county roads, structures in the area, water bodies and other prominent physical features. Figure 2.1-4 is an aerial photograph of the site area itself looking in a generally southerly direction. There are no major industrial developments in the immediate vicinity.

The total area of the site is 1,940 acres. Of this area, approximately 300 to 350 acres will actually be utilized for the plant and related facilities.

A visitors' center will be constructed on site. The center is not designed as yet, but the facilities could include such items as an overlook and parking area, a reception and display area, and an auditorium or theater. Based on visitation at existing TVA steam plants and projected visits to the visitor facilities planned for other

TVA nuclear plants, as well as on the Hartsville site's location with respect to major highways, population centers, and other area visitor attractions, TVA estimates that the minimum average annual visitation which can be expected at the plant's visitors' center facilities will be in the range of 65,000 to 75,000 visits per year.

A natural gas transmission line traverses the northern portion of the site as indicated on Figure 2.1-2, and an associated gas pumping station is located immediately adjacent to the northeast portion of the site. Safety-related investigations of this pipeline are presently being conducted by a consultant, Mechanics Research Incorporated, under contract to TVA. Preliminary findings indicate that the pipeline and pumping station will not present any significant safety problem. A more detailed discussion of this subject is found in the Preliminary Safety Analysis Report. It is not expected that plant construction will adversely affect pipeline operation.

Figure 2.1-1
HARTSVILLE VICINITY MAP
(Site location - 86° 05' 09.8" W, 36° 21' 15.2" N)

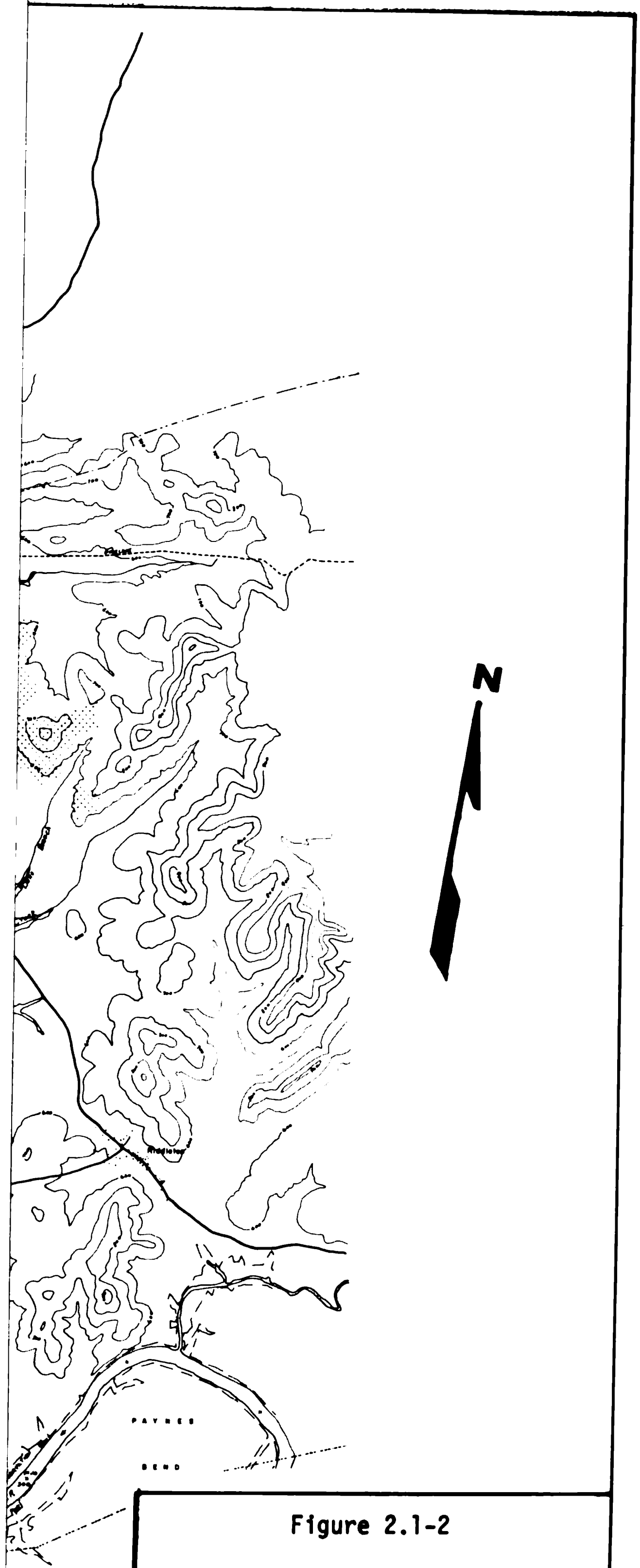

Figure 2.1-2

HARTSVILLE AREA TOPOGRAPHIC MAP

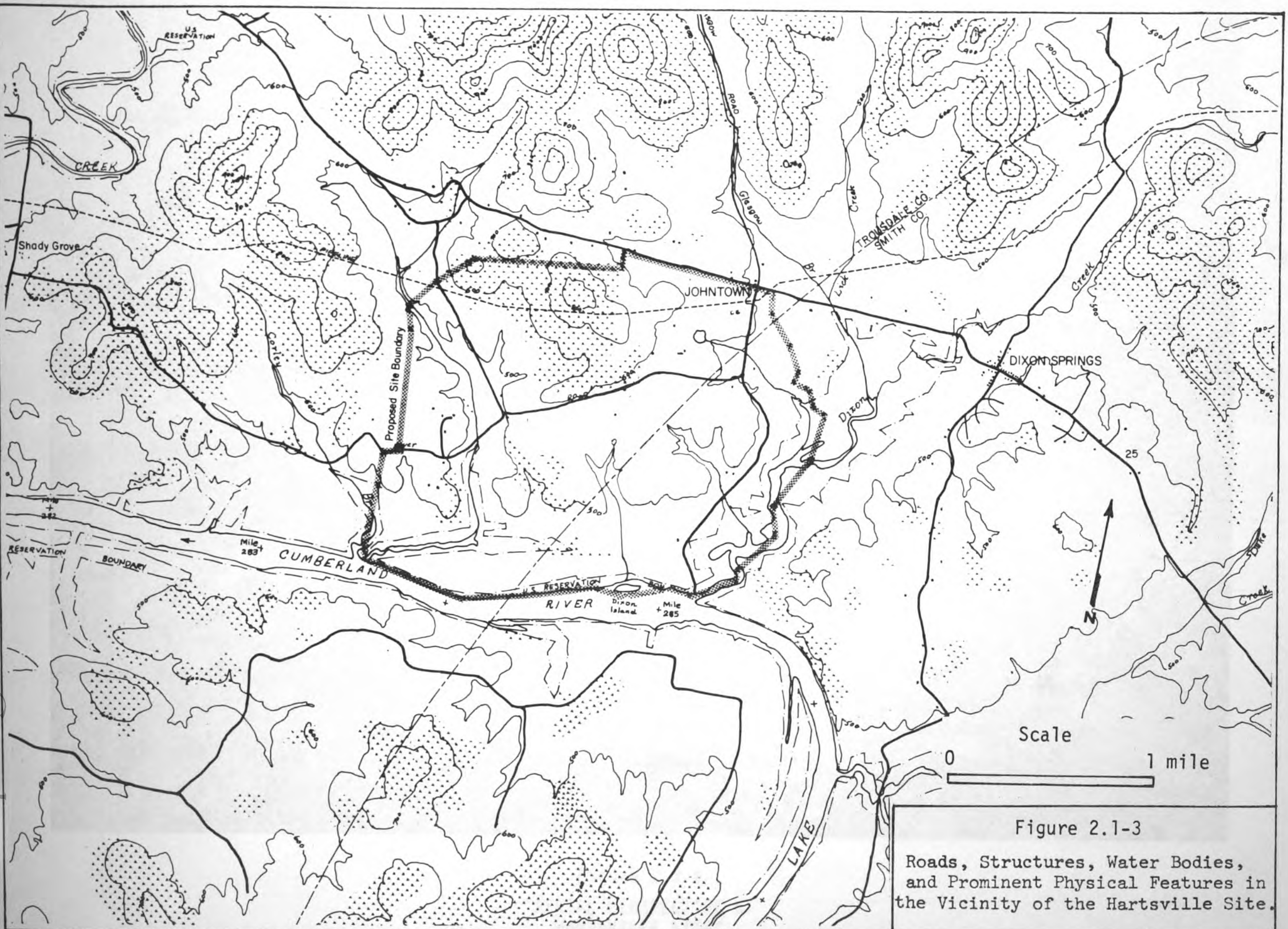

Figure 2.1-3

Roads, Structures, Water Bodies, and Prominent Physical Features in the Vicinity of the Hartsville Site.

Figure 2.1-4
"AERIAL PERSPECTIVE OF
HARTSVILLE SITE"

<u>2.2.1 Population Distribution</u> - Present and projected population information is contained in this section. Present resident population data is from the 1970 Census of Population. Within 10 miles, transient and institutional populations are included in addition to resident population. Figure 2.2-1 shows the location of towns and cities within a ten-mile radius of the Hartsville site. From 10 to 50 miles, only resident population data is presented. Figure 2.2-2 shows the location of towns and cities within a 50-mile radius of the Hartsville site.

<u>2.2.1.1 Population Within 10 Miles - Resident Population</u> - Only slightly more than 12,000 people are located within 10 miles of the Hartsville site, with over 9,700 between 5 and 10 miles. Since no community of 1,000 or more exists within 5 miles of the plant site, resident population is extremely sparsely distributed. Two small towns are located between 5 and 10 miles. They are Hartsville (5 miles northwest), with a population of 2,243, and Carthage (10 miles southeast), containing 2,491 people. Virtually all of the projected population increase in the area is expected to concentrate in these two communities. However, the magnitude of the increase and the distance from the site are such that this growth should not have any impact on the land use or population distribution in the immediate vicinity of the site.

Figures 2.2-3 through 2.2-8 show the present and projected populations to the year 2020 at various distances and directions from the site out to 10 miles.

<u>Institutional Population</u> - Virtually all of the institutional population within 10 miles of the site is comprised of school children. Table 2.2-1 contains the data relative to existing and projected school

enrollments. Presently, two of the schools (Trousdale County and Cox-Davis Elementary) are located within 5 miles. By 2020, three are projected to be within 5 miles - Trousdale County Elementary, a new elementary school and a new middle school. All three of these projected schools are located in the vicinity of Hartsville.

Hospitals and extended care facilities contain the remaining institutional population. Hartsville contains a hospital (34 beds) and one extended care facility (42 beds). Carthage also contains one hospital (43 beds) and one extended care facility (48 beds). East of Carthage is a second hospital (29 beds).

There are no known expansion plans for any of these health care facilities. However, there is an existing need for an additional 15 hospital beds and 33 extended care beds in Trousdale County and an additional 40 hospital beds and 31 extended care beds in Smith County. No projections of facility needs are available, but additional expansion to meet projected population growth can be expected.

Transient Population - Recreation facilities account for the transient population within 10 miles of the site. The estimated average peak hour use, both existing and projected, is shown in Table 2.2-2. No recreation areas are located within 2 miles of the plant site and only one area is in the 2-3 mile range. Since most of these recreation areas serve primarily local residents, a portion of the attencance figures are a redistribution of resident population within 10 miles.

Based on visitation at existing TVA steam plants and projected visits to the visitor facilities planned for other TVA nuclear plants,

as well as on the Hartsville site's location with respect to major highways, population centers, and other area visitor attractions, the estimated minimum average annual visitation which can be expected at the visitors' facility will be in the range of 65000 to 75000 visits per year. Plans are not yet available on the location of the visitors' facility.

<u>2.2.1.2 Population Within 50 Miles</u> - During the decade from 1960 to 1970, the population growth rate within 50 miles was approximately 14 percent which is slightly greater than that of the nation's 13 percent. This is based on the population growth for the 27 counties which have at least 5 percent of their population within the 50-mile radius. Of the 999,351 people in these 27 counties, 891,355 were located inside that radius.

Nashville-Davidson County is the only major urban concentration (a population of 50,000 or more) within 50 miles of the site. The urbanized area extends from about 28 to 50 miles from the site to the west-southwest and contained a population of 448,444 in 1970.

The following tabulation shows seven smaller population centers (population of 10,000 to 50,000) which are scattered around the region. Of those, two are expected to reach 50,000 people between 1980 and 1990 - Murfreesboro, Tennessee and Bowling Green, Kentucky.

City	Distance - Miles	Direction	1970 Population
Lebanon, Tennessee	16	SW	12,492
Gallatin, Tennessee	21	W	13,271
Cookeville, Tennessee	35	ESE	14,270
Murfreesboro, Tennessee	39	SSW	26,360
Glasgow, Kentucky	45	NNE	11,301
Bowling Green, Kentucky	48	NNW	36,253
McMinnville, Tennessee	50	SSE	10,662

Numerous smaller communities and crossroads settlements are dispersed throughout the rest of the region and are surrounded by low-density rural development.

Detailed present and projected population distribution information is shown in Figures 2.2-9 through 2.2-14. The predominant sectors in 1970 are the four to the W and WSW in the 30- to 50-mile range which cover Nashville. They account for about 53 percent of the total population within 50 miles. By 2020, a slight change in the distribution is expected to occur but these same four sectors are still expected to account for about 47 percent of the total.

2.2.2 Land Use - Urban development is extremely sparse in the vicinity of the plant site as can be seen in Figure 2.2-15. Two small communities, Dixon Springs and Riddleton, are nearby, but Hartsville is the nearest town with a significant economic or population base.

Carthage - South Carthage to the southeast is somewhat larger and farther away. Industrial development is found almost exclusively within or immediately adjacent to these larger communities. Agriculture is the predominant land use in the area and is discussed in more detail below.

Figure 2.2-16 is a topographic map of the site vicinity which shows the location of a number of cultural features. Figure 2.2-17 presents photographs of these features keyed to the index numbers. An arrow next to a circle indicates the general direction from which the relevant photograph was taken.

On-Site Features - Photo 1 shows the grave of Reverend John McGee. A view of the center of the site which also includes the Edd Seay Gregory residence and part of the surrounding farm is shown on photo 2. These features are discussed in section 2.3. Photo 3 shows another early farm residence. Photo 4 shows a more contemporary farm residence and more of the site.

Off-Site Features - Photos 5 and 6 show the intersection of the two existing access roads to the site with state highway 25. Photo 7 provides a view of Dixon Springs from the intersection of the bypass and the old road through town.

Recreation uses are primarily along the Old Hickory Reservoir. The exception is the golf course just southeast of Dixon Springs. Three major points of recreation use are coincident with the Old Hickory Wildlife Management and Refuge Area on the left bank of the reservoir in the vicinity of the upstream limits of the refuge. (See figure 2.2-15.)

From a statistical point of view, agriculture, either cropland or pasture, accounts for 52 percent of the land in Smith and Trousdale Counties. Forest cover is an additional 37 percent. Urban and industrial build-up comprise about 3 percent. The remaining area is taken up by the reservoirs (Old Hickory and Cordell Hull), small water areas, and other land categories[a]. The total agricultural acreage in the combined Smith-Trousdale County area is 109,129 acres, with Smith County comprising 84,083 acres and Trousdale County 25,046.

A general soil association and agricultural suitability map for Smith and Trousdale Counties, Tennessee is illustrated by figure 2.2-18. The location of the nuclear plant and the land purchase area is delineated on this map.

As indicated by the soils legend, most of the proposed purchase area is represented by soil associations 3 and 6, which are generally good cropland and pasture soils. These particular soil areas are characterized by level to gently rolling, deep, well-drained fertile soils developed from limestone and from alluvial sediments along the Cumberland River and its tributaries.

Cleared land occupies approximately 1,750 acres of the proposed 1,940-acre purchase area, with woods comprising the remaining 190 acres. Pasture and hay crops occupy about 1,575 acres of the cleared land, while the remainder is in corn, soybeans, tobacco, or home vegetable gardens.

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a. Reference 1967 Conservation Needs Inventory.

Projected changes in land use are found primarily on the periphery of Carthage and Hartsville. They are expected to consist of additional industrial, residential, and institutional expansion. Future land use information was obtained from the "Smith County General Plan" (June 1969) and "The General Plan - Hartsville, Tennessee" (May 1973). These documents were prepared by the Tennessee State Planning Office. Development of the proposed site for electric generating purposes is not expected to significantly change the general development pattern of the area. Further discussion of some small-scale land use impacts is found in Section 4.2 Socioeconomic Impact.

2.2.3 Water Use

2.2.3.1 Surface Water Use - A list of public and industrial surface water supplies within a 20-mile radius of the plant site and supplies taken from the Cumberland River between Cordell Hull and Old Hickory Dams is shown in Table 2.2-3. The approximate locations of these are shown in Figure 2.2-19. Table 2.2-4 lists potable water supplies for all population centers taking water from the Cumberland River between Old Hickory Dam and the mouth of the river.

The use of surface water for irrigation has not been extensive in recent years due to high annual rainfalls. A total of 52,572,000 gallons of surface water per year is the estimated consumption for irrigation from Old Hickory Reservoir. Table 2.2-5 lists the surface water use for irrigation by county. There is no present use of surface water for transportation, other than small private craft.

Recreational water use is primarily limited to Old Hickory Reservoir. There is no significant recreation visitation to the plant site. In 1972, the U.S. Army Corps of Engineers estimated that there were 5,266,000 recreation visits to the reservoir downstream of the plant site to Old Hickory Dam and 212,000 visits upstream of the site to Cordell Hull Dam.

The dilution rates and transport times for the Cumberland River from the Hartsville site are discussed in Section 2.5.1.4.

2.2.3.2 Ground-Water Use - Public and industrial ground-water use within a 20-mile radius of the Hartsville site is limited, constituting less than ten percent of the total average daily use of 5,650,000 gpd (gallons per day). Three public water supplies and two industrial water supplies depend on ground water, as tabulated below:

	Approximate Radial Distance From Site miles	Estimated Population Served	Average Daily Use gpd	Source
Public Supply				
LaFayette	13	3,500	281,600	Springs
Red Boiling Springs	19	1,000	160,000	Springs
Watertown	17	1,100	70,000	Wells
Industrial Supply				
J. B. Cassidy LBR	12		2,000	Wells
Cumberland Charcoal	11		4,000	Wells

Total ground-water use: 517,600 gallons per day

No well now exists that can cause drawdown to affect the Hartsville site, nor is it believed possible for any neighboring well to develop a cone of depression large enough to affect the site, because of the low permeability of the rocks of the area. Within a two-mile radius of the plant site, ground water is used for domestic and stock supply only, as summarized in table 2.5-8.

TABLE 2.2-1

INSTITUTIONAL POPULATION:
PUBLIC SCHOOLS IN TEN MILE RADIUS OF
HARTSVILLE NUCLEAR SITE, 1973-2020

System No.	School	Grade Org.	Direction	Distance (Miles)	Capacity	1973	1980	Enrollment 1990	Enrollment 2000	2010	2020
Trousdale County											
1.	Trousdale County Elementary	K-6	NW	3.7	750	615	700	700	700	700	700
2.	Trousdale County High School	7-12	WNW	5.5	600	527	600	500	500	500	500
3.	New Middle School	6-8	NW	4.1	600	---	---	300	400	500	600
4.	New Elementary School	3-5	NW	4.3	500	---	---	---	---	---	400
Smith County											
5.	Carthage Elementary	K & 3-5	SE	9.8	540	659	500	500	500	500	500
6.	Cox-Davis Elementary	1-8	ESE	3.1	165	114	Closed	---	---	---	---
7.	Defeated Elementary	K-8	E	9.9	150	129	Closed	---	---	---	---
8.	Pleasant Shade Elementary	1-8	ENE	7.2	120	79	Closed	---	---	---	---
9.		Spec. Ed. & K-2	SE	9.8	225	223	Closed	---	---	---	---
10.	Smith County High School	9-12	SE	9.8	600	680	500	400	Closed	---	---
11.	Union Heights Elementary	1-8	SSE	6.8	195	185	200	Closed	---	---	---
12.	New Elementary School	1-6	SE	9.0	600	---	---	400	500	600	600
13.	New Middle School	7-9	SE	9.0	1000	---	---	---	500	700	900
*14.	New High School	10-12	SE	9.0- or greater	1500	---	1100	1200	1400	1400	1400
State											
15.	Hartsville Area Vocational-Technical School		WNW	4.1	210	115	200	300	400	400	400

*Location to be determined

Table 2.2-2

ESTIMATED AVERAGE PEAK HOUR USE AT RECREATIONAL AREAS

WITHIN 10 MILES OF PLANT SITE*

Mileage Zone	Site Number	1971	1980	1990	2000	2010	2020
1	None	-	-	-	-	-	-
2	None	-	-	-	-	-	-
3	16	140	150	150	150	150	150
4	1	30	40	40	50	60	60
	17	70	80	100	120	140	160
5	2	30	40	40	50	60	60
6-10	5	30	40	40	50	60	60
	6	30	40	40	50	60	60
	7	110	140	170	200	230	260
	8	60	70	80	100	120	130
	9	230	280	350	410	470	530
	10	230	280	350	410	470	530
	11	140	170	210	250	290	320
	14	40	40	50	60	70	80
	18	110	140	160	200	220	250
Total	13	1,250	1,510	1,780	2,100	2,400	2,650

*Peak-hour use estimates for 1971 based on extrapolation of 1971 annual visitation data obtained from U.S. Corps of Engineers' Nashville District office. Future peak-hour use estimated by TVA Recreation Resources Branch based on projected regional changes in recreation participation as reported in 1969 Tennessee Statewide Comprehensive Outdoor Recreation Plan.

Peak-hour estimates based on estimated July 4 levels of use.

Table 2.2-3

Surface Water Supplies Within a 20-Mile Radius
of the Hartsville Site and Supplies Taken from the
Cumberland River between Cordell Hull and Old Hickory Dams

	Water Supply	Approximate Distance From Site[1]	Estimated Population Served	Average Daily Use	Source
	Public Supplies	Miles		Gallons	
1.	Carthage	24.0	3,070	209,000	Surface (CRM 309.0)
2.	Hartsville	6.4	2,500	300,000	Surface (CRM 278.6)
3.	Gallatin	45.8	17,620	2,145,000	Surface (CRM 239.2)
4.	Lebanon	22.1	17,550	2,800,000	Surface (CRM 262.9)
5.	Camp Boxwell	49.0	750	11,000	Surface (CRM 236.0)
6.	Easter Seal's Crippled Children's Camp	49.0	800	5,000	Surface (CRM 236.0)
7.	Old Hickory Dam and Recreation Area	68.8	6,200	43,400	Surface (CRM 216.2)
8.	Whitehouse Utility District	68.5	12,760	40,600	Surface (CRM 216.5)
9.	Old Hickory Utility District	66.0	13,900	973,000	Surface (CRM 219.0)
10.	Smith Utility District	15.0	1,800	531,100	Surface (Caney Fork River Mile 7.7)
11.	Westmoreland	17.0	1,200	125,000	Surface (Reservoir)

Table 2.2-3 (Continued)

Surface Water Supplies Within a 20-Mile Radius of the Hartsville Site and Supplies Taken from the Cumberland River between Cordell Hull and Old Hickory Dams

Water Supply	Approximate Distance From Site[1]	Estimated Population Served	Average Daily Use	Source
Industrial Supplies				
1. Gallatin Steam Plant	41.4	270	5,400	Surface (CRM 243.6)
2. Hugh Dixon LST Co.	12.0		25,000	Surface (Stream)

1. Radial distance to all supplies except those that take water directly from the Cumberland River which are shown as river mile distance from mile 285.0.

SOURCE: Water Use in Tennessee by Counties - 1970, State of Tennessee, Department of Conservation.

Table 2.2-4

Surface Potable Water Supplies Taken from the Cumberland River Between Old Hickory Dam and the Mouth

Public Water Supply	Approximate Distance From Plant Site River Miles	Estimated Population Served	Average Daily Use Gallons	Source
1. Cumberland Water Company	77.3	10,400	855,000	Surface (CRM 207.7)
2. Madison Suburban Utility District	84.8	35,000	6,000,000	Surface (CRM 200.2)
3. Nashville	91.2	465,000	60,000,000	Surface (CRM 193.8)
4. Harpeth Valley Utility District	112.5	19,600	1,500,000	Surface (CRM 172.5)
5. River Road Utility District	125.1	400	14,000	Surface (CRM 159.9)
6. Cheatham Dam and Recreation Area	136.3	2,000	20,000	Surface (CRM 148.7)
7. Clarksville	158.5	45,840	3,570,000	Surface (CRM 126.5)
8. Dover	195.5	1,400	125,000	Surface (CRM 89.5)
9. Kentucky State Penitentiary	241.3	1,200	120,000	Surface (CRM 43.7)
10. Barkley Dam and Recreation Area	254.4	1,870	19,000	Surface (CRM 30.6)

SOURCE: Water Use in Tennessee by Counties - 1970 and 1972, State of Tennessee, Department of Conservation. State of Kentucky, Department of Public Health.

Table 2.2-5

Surface Water from Old Hickory Reservoir Used for Irrigation by County

County	Gallons of Irrigation Water Used Per Year
Smith	18,750,000
Trousdale	16,675,000
Sumner	272,000
Wilson	16,875,000

SOURCE: Interviews with county extension agents in the respective counties.

Figure 2.2-1

VICINITY MAP WITHIN
10 MILE RADIUS
HARTSVILLE NUCLEAR PLANTS

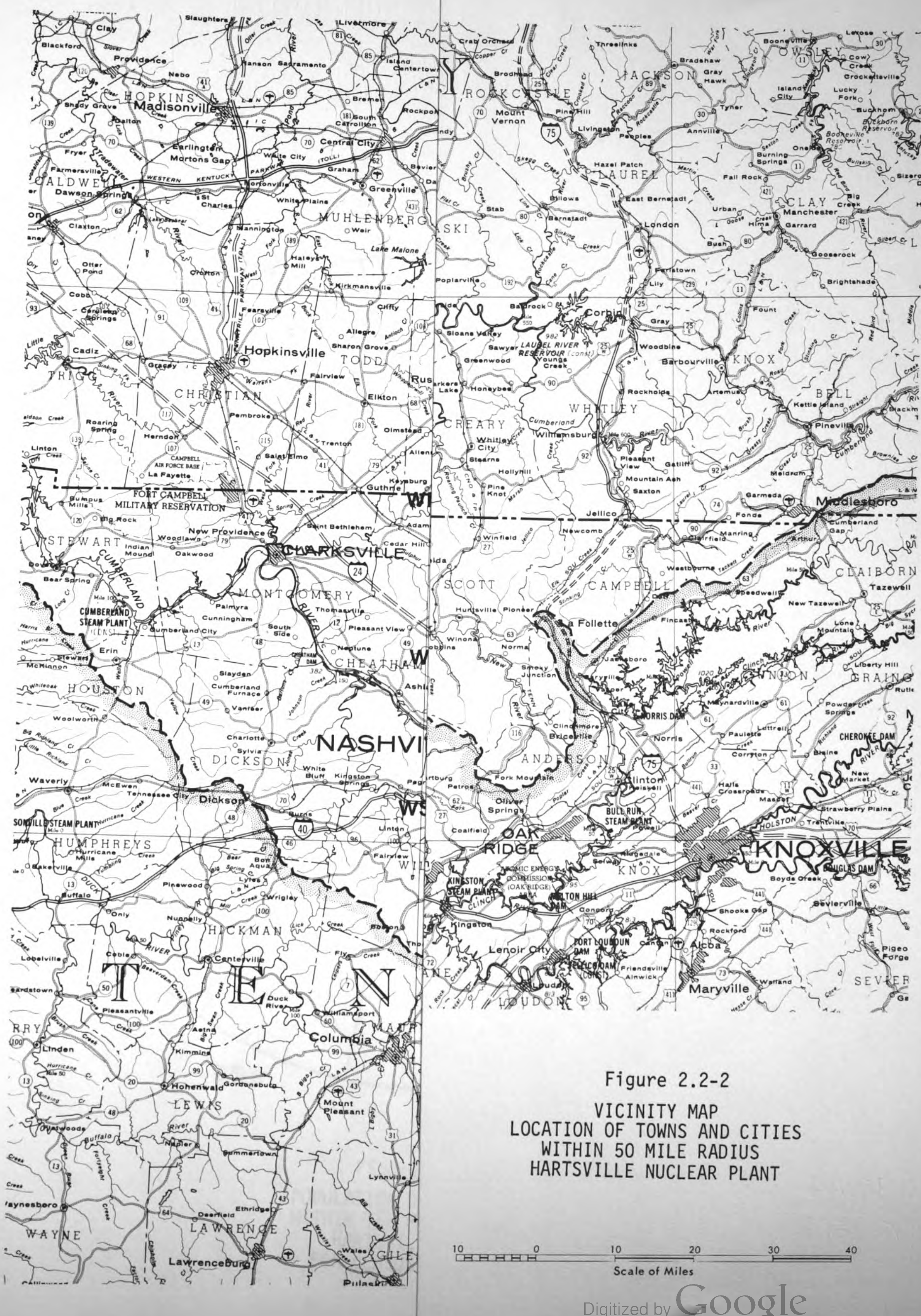


Figure 2.2-2

VICINITY MAP
LOCATION OF TOWNS AND CITIES
WITHIN 50 MILE RADIUS
HARTSVILLE NUCLEAR PLANT

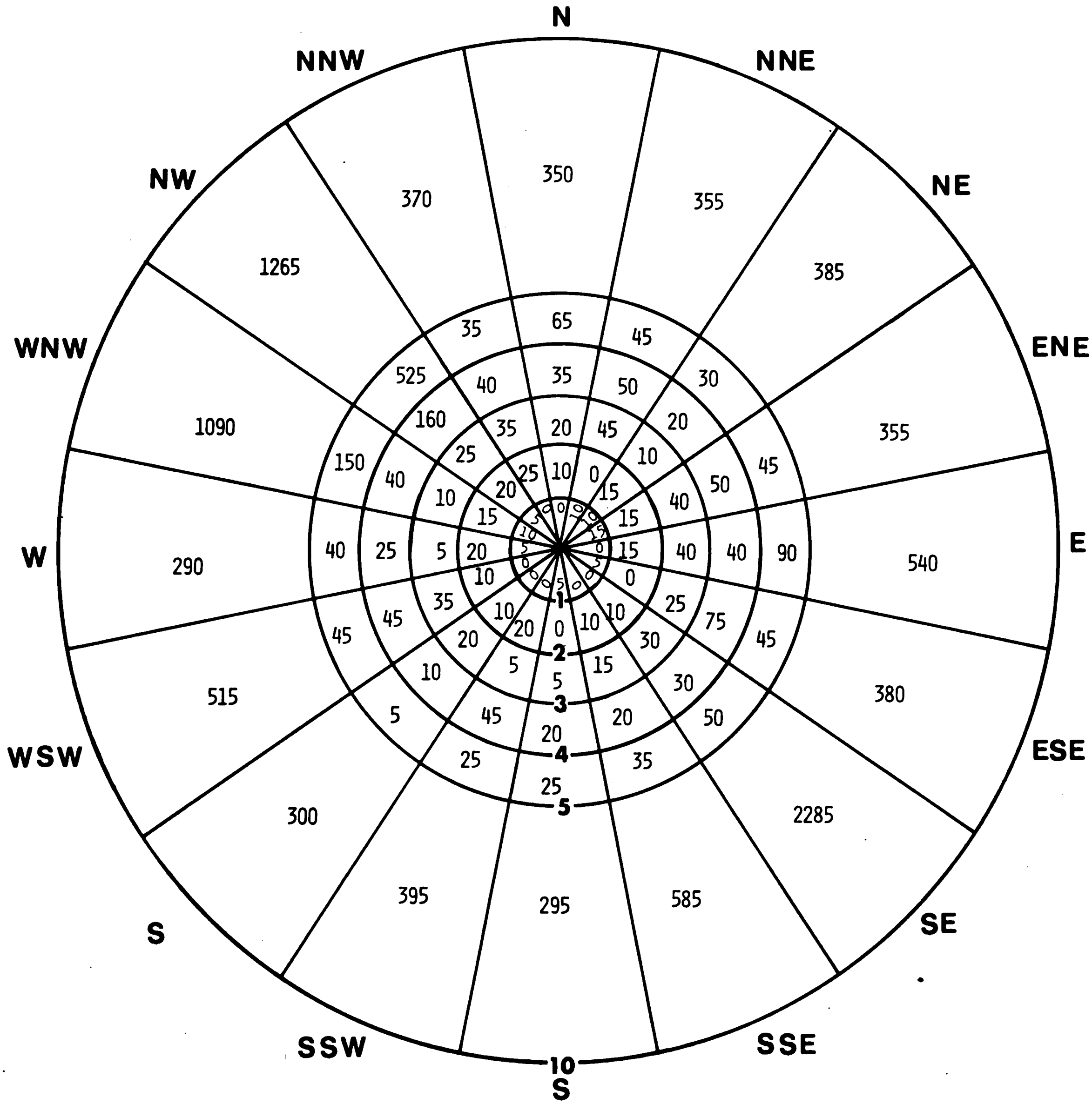


Figure 2.2-3

POPULATION DISTRIBUTION
WITHIN TEN MILES OF THE
HARTSVILLE PLANT
FOR CENSUS YEAR 1970

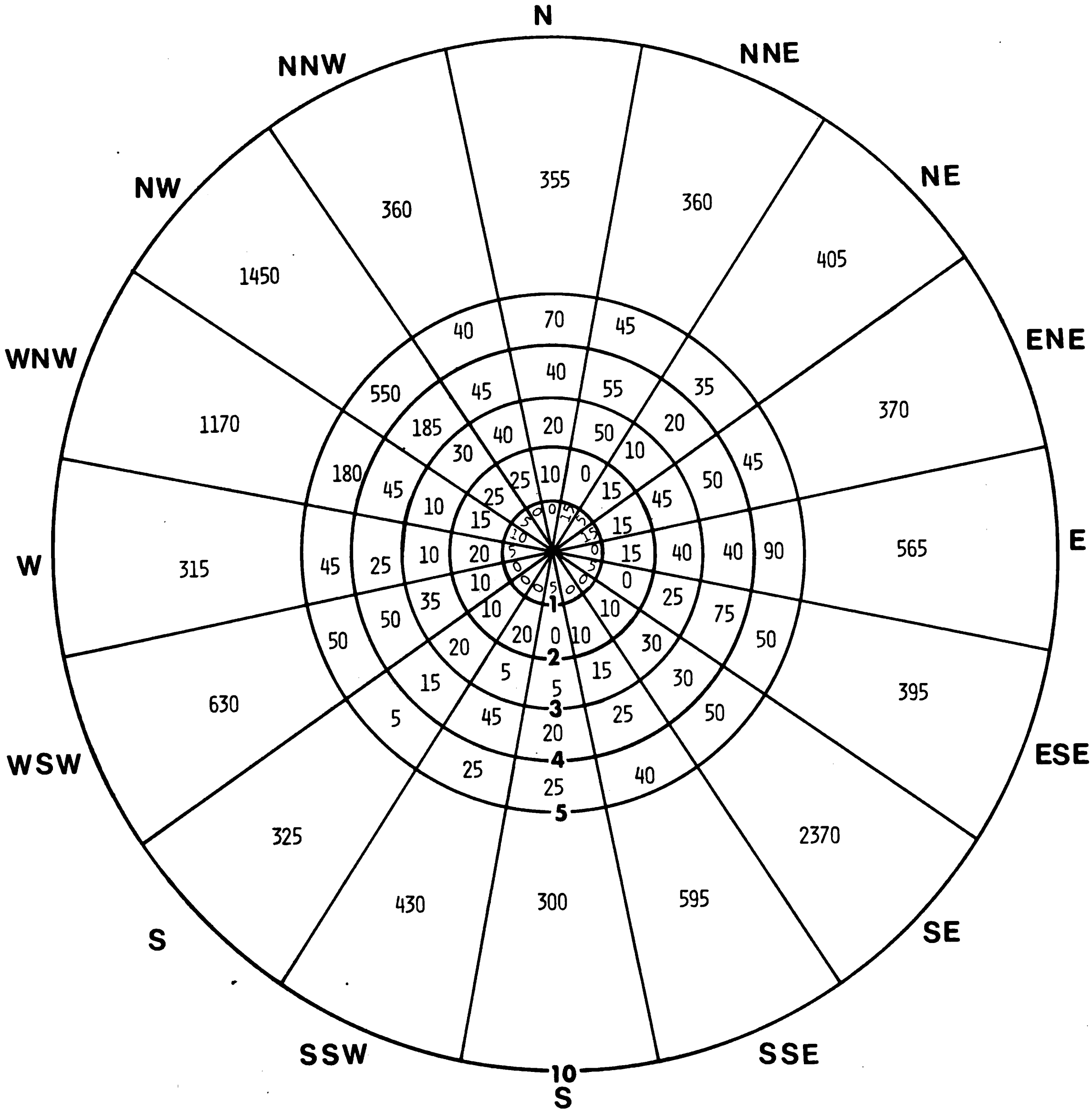


Figure 2.2-4

PROJECTED POPULATION DISTRIBUTION
WITHIN TEN MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 1980

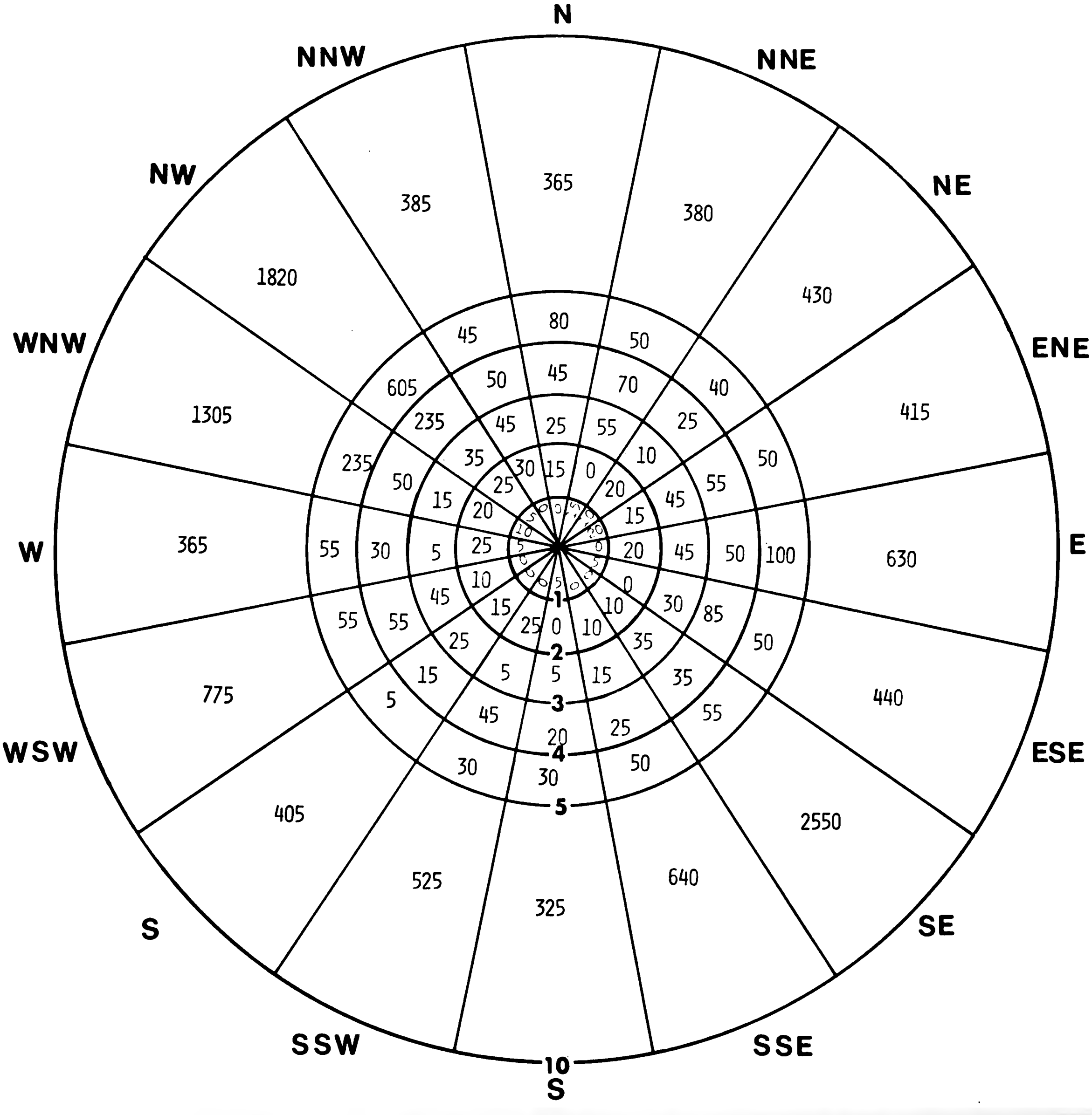


Figure 2.2-5

PROJECTED POPULATION DISTRIBUTION
WITHIN TEN MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 1990

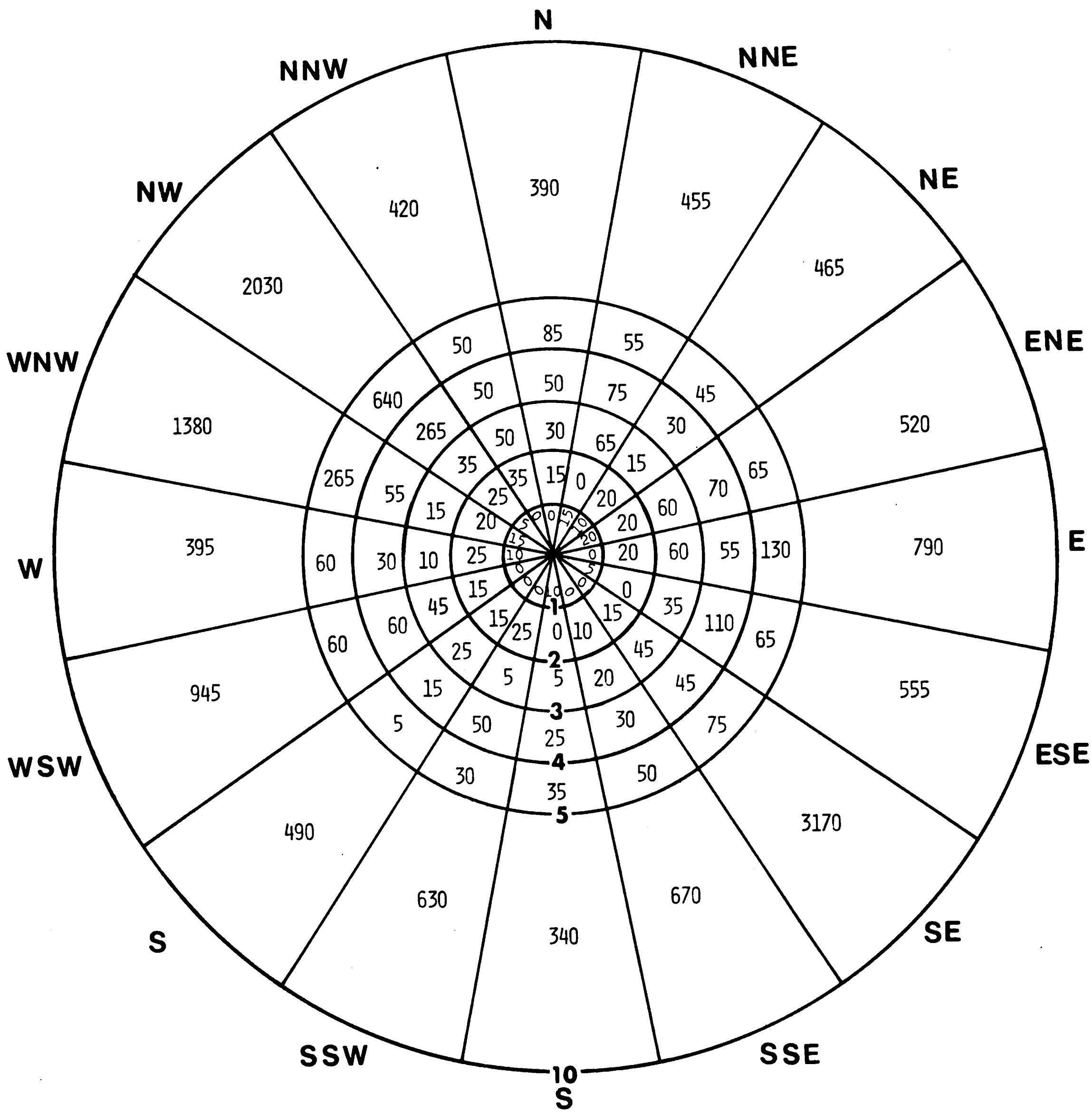


Figure 2.2-6

PROJECTED POPULATION DISTRIBUTION
WITHIN TEN MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 2000

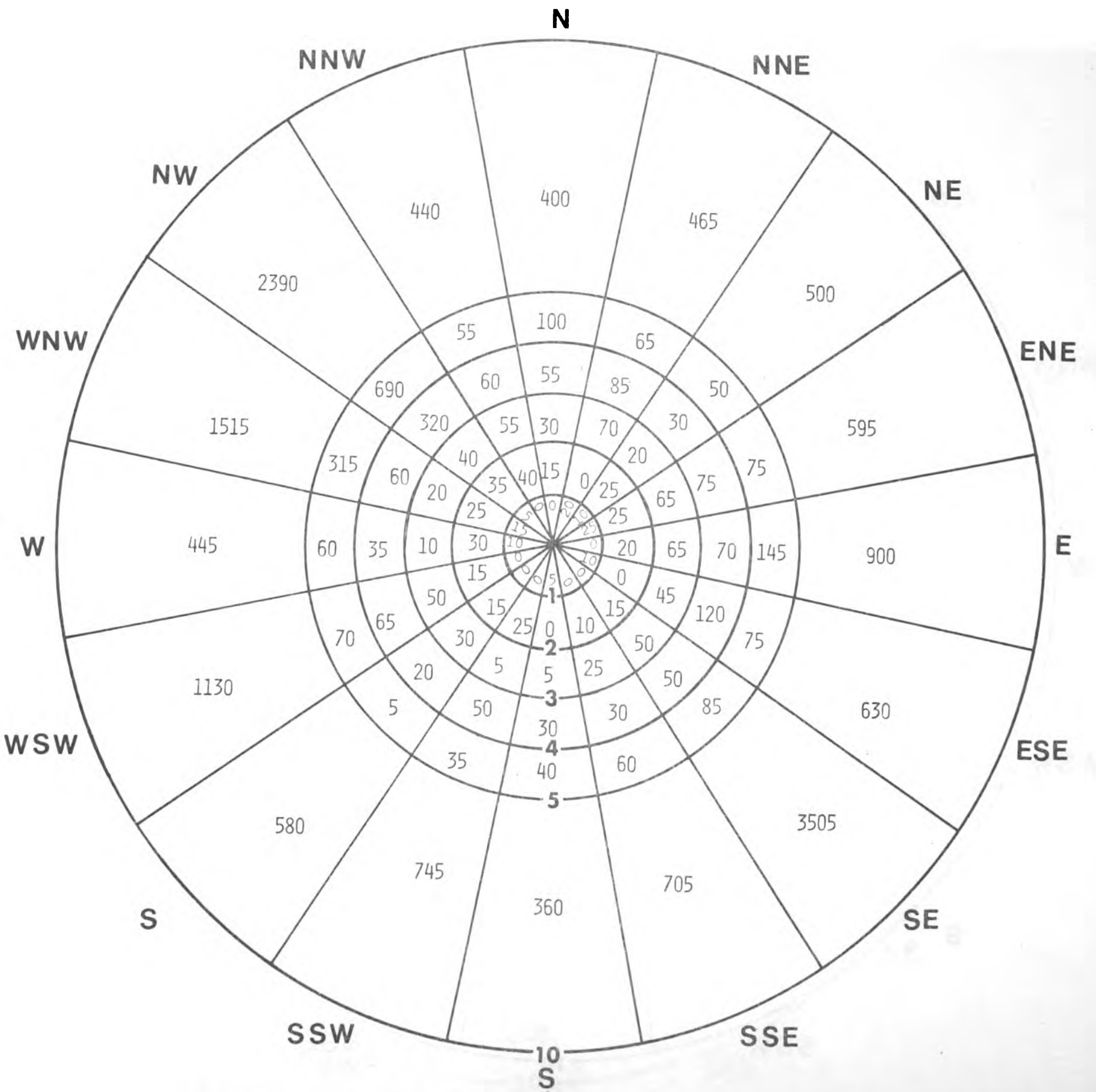


Figure 2.2-7

PROJECTED POPULATION DISTRIBUTION
WITHIN TEN MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 2010

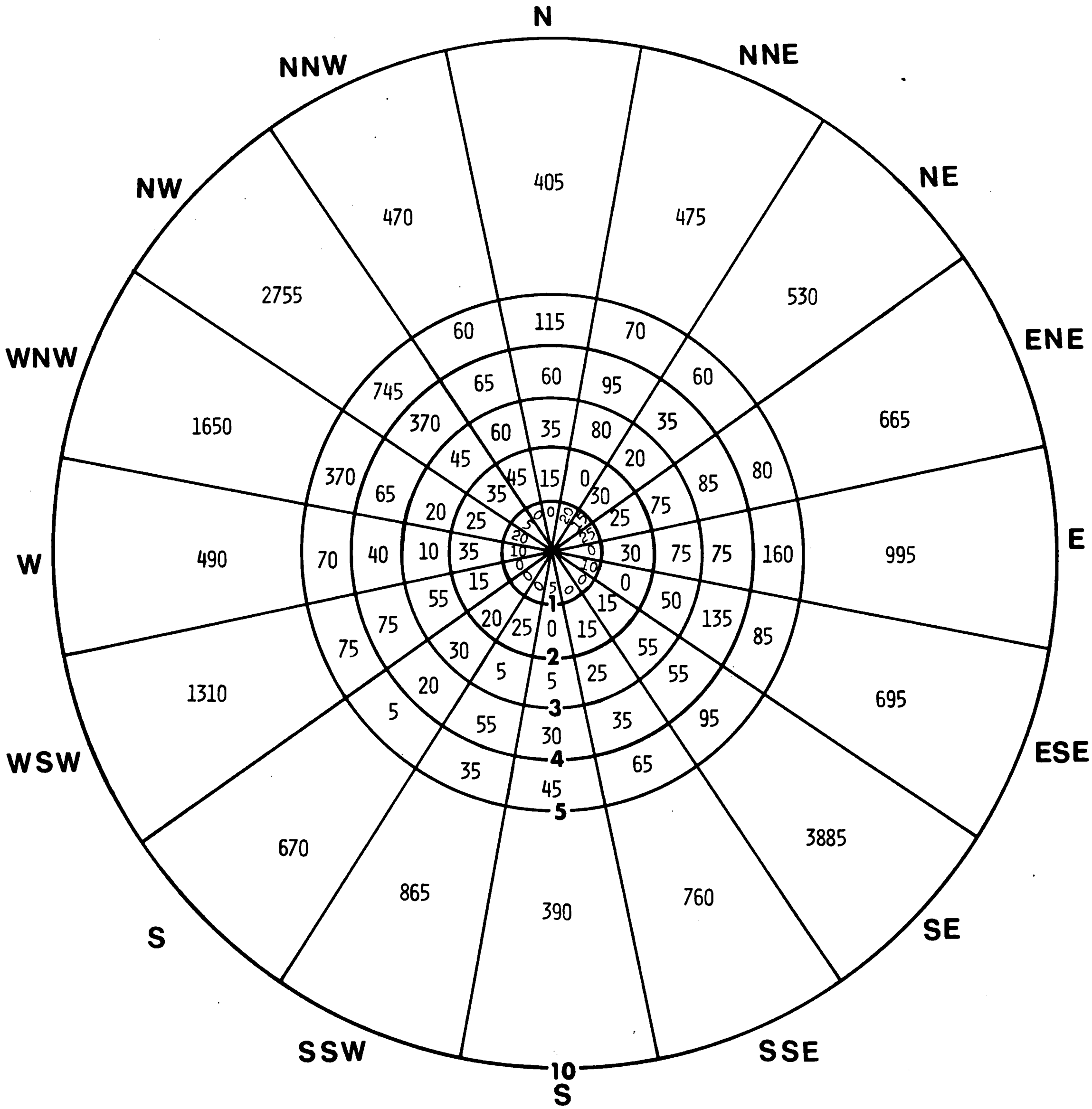


Figure 2.2-8

PROJECTED POPULATION DISTRIBUTION
WITHIN TEN MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 2020

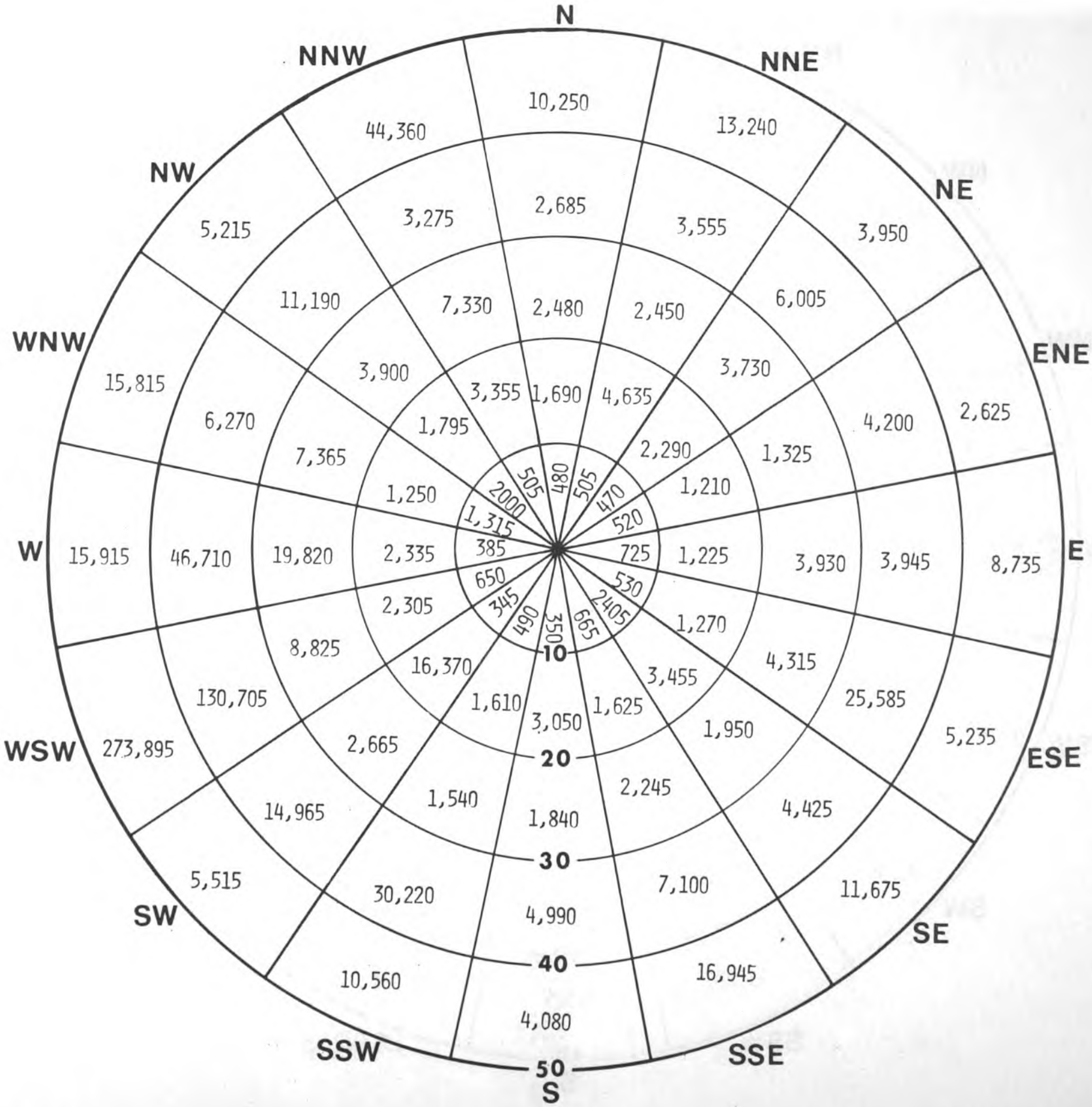


Figure 2.2-9

POPULATION DISTRIBUTION WITHIN
50 MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 1970

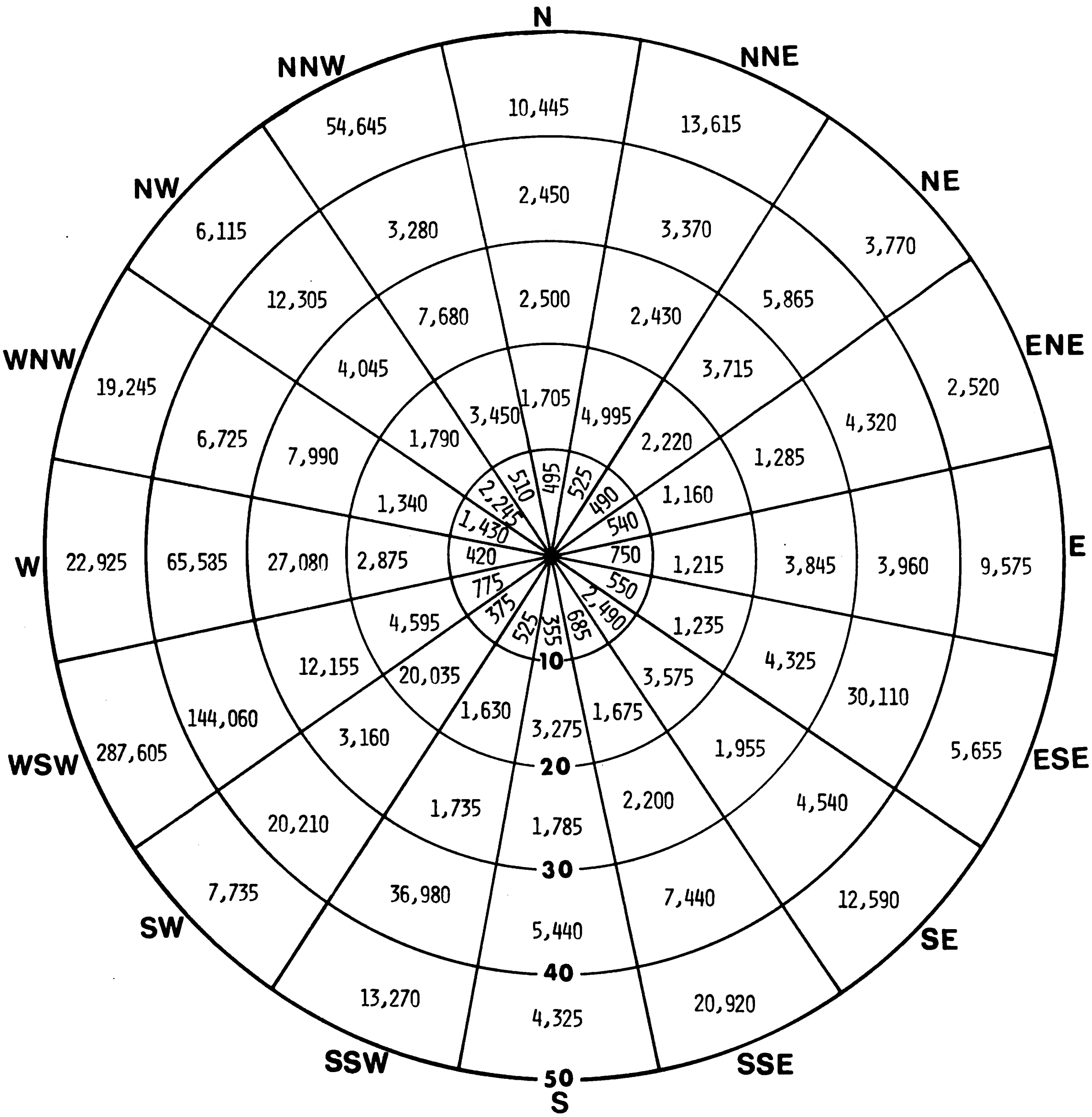


Figure 2.2-10

PROJECTED POPULATION DISTRIBUTION
WITHIN 50 MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 1980

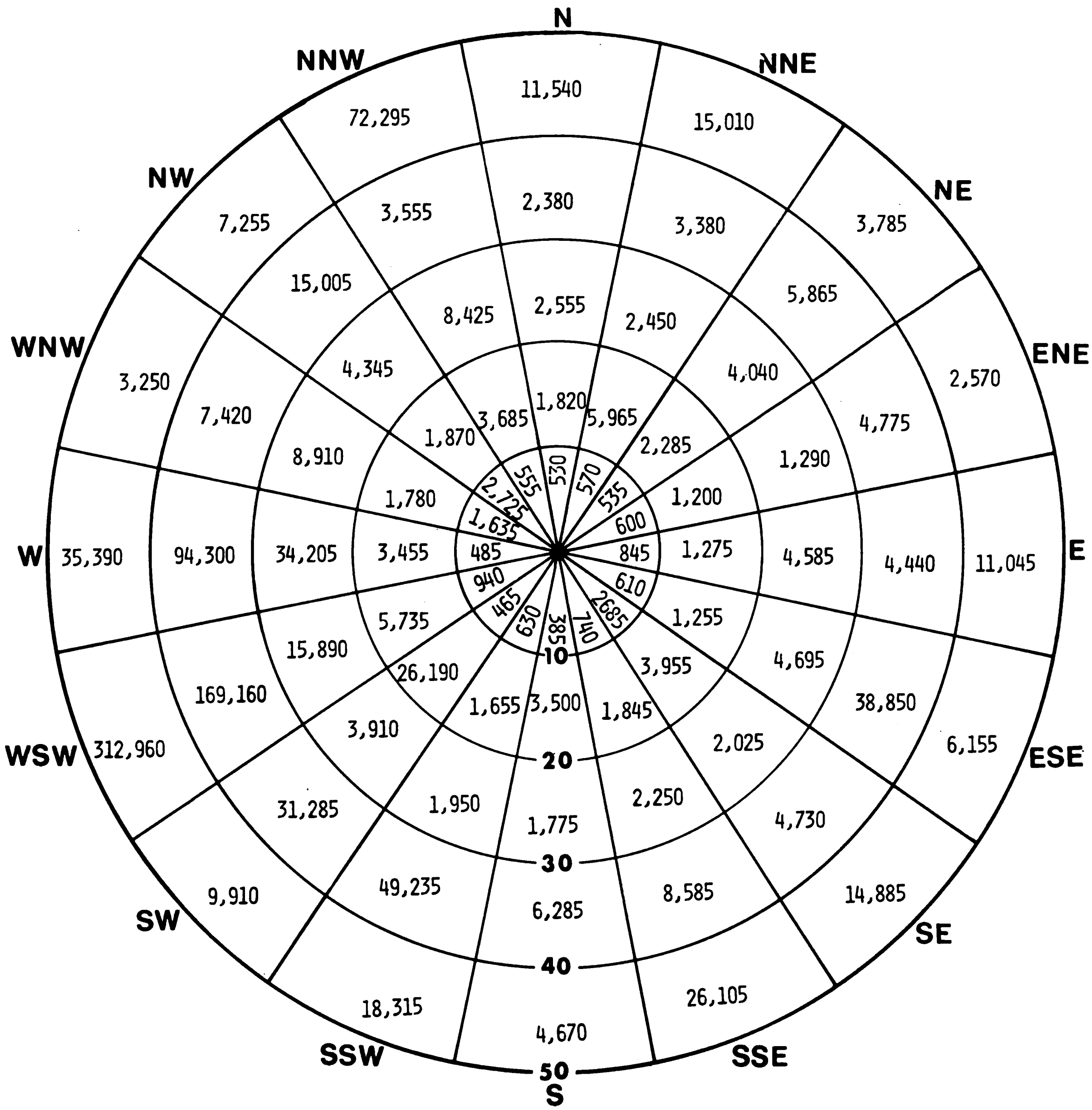


Figure 2.2-11

PROJECTED POPULATION DISTRIBUTION
WITHIN 50 MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 1990

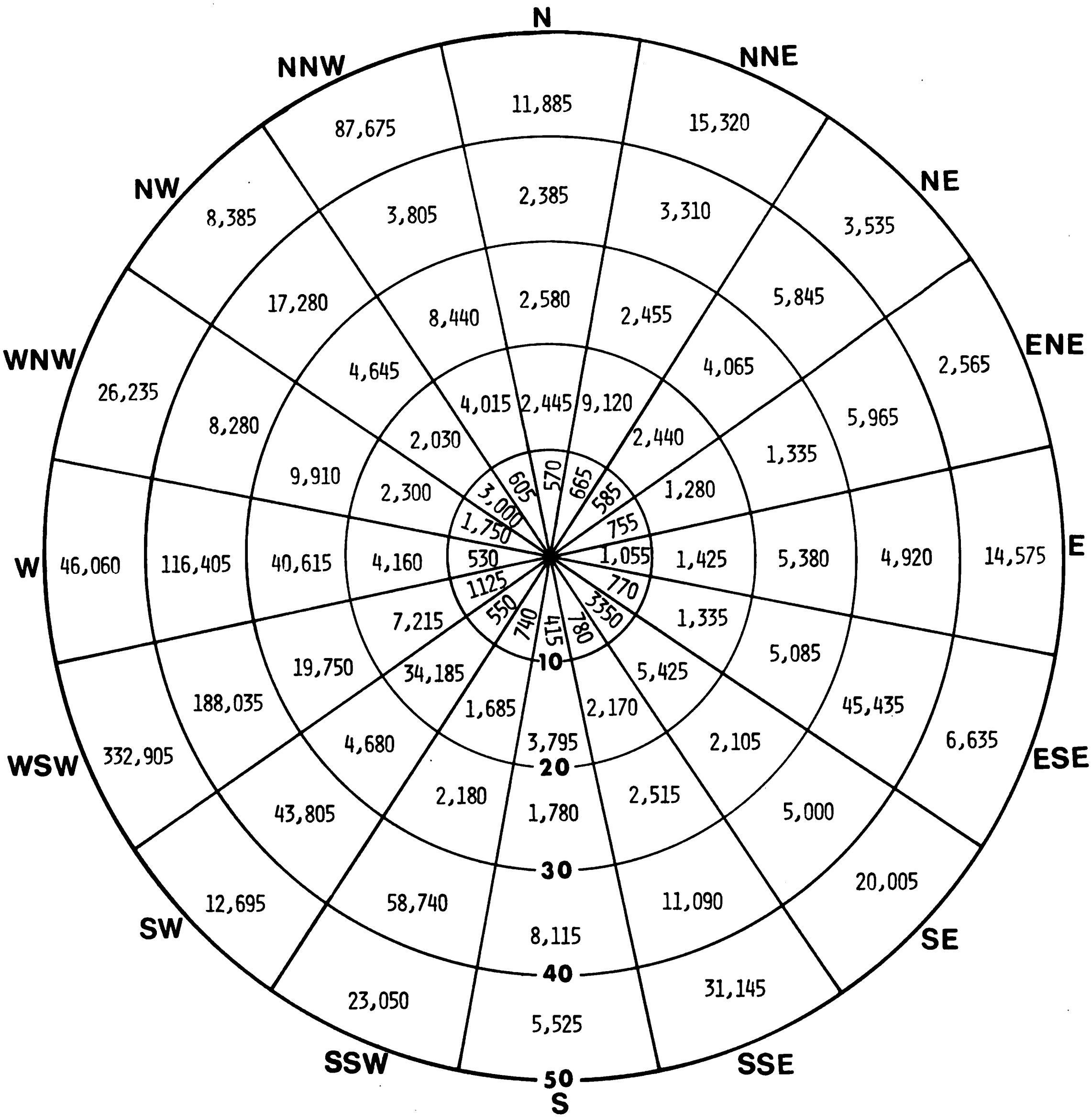


Figure 2.2-12

PROJECTED POPULATION DISTRIBUTION
WITHIN 50 MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 2000

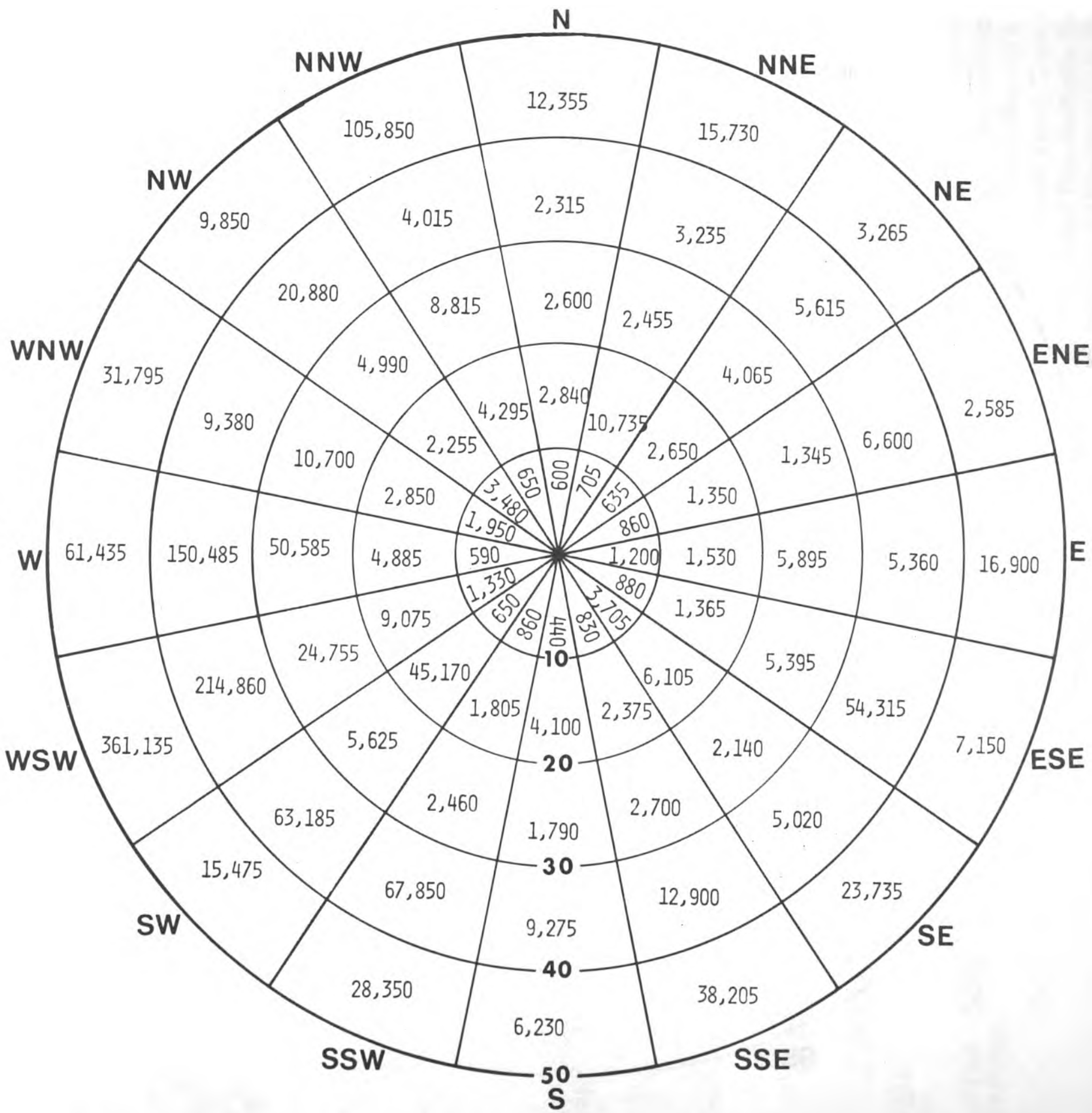


Figure 2.2-13

PROJECTED POPULATION DISTRIBUTION
WITHIN 50 MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 2010

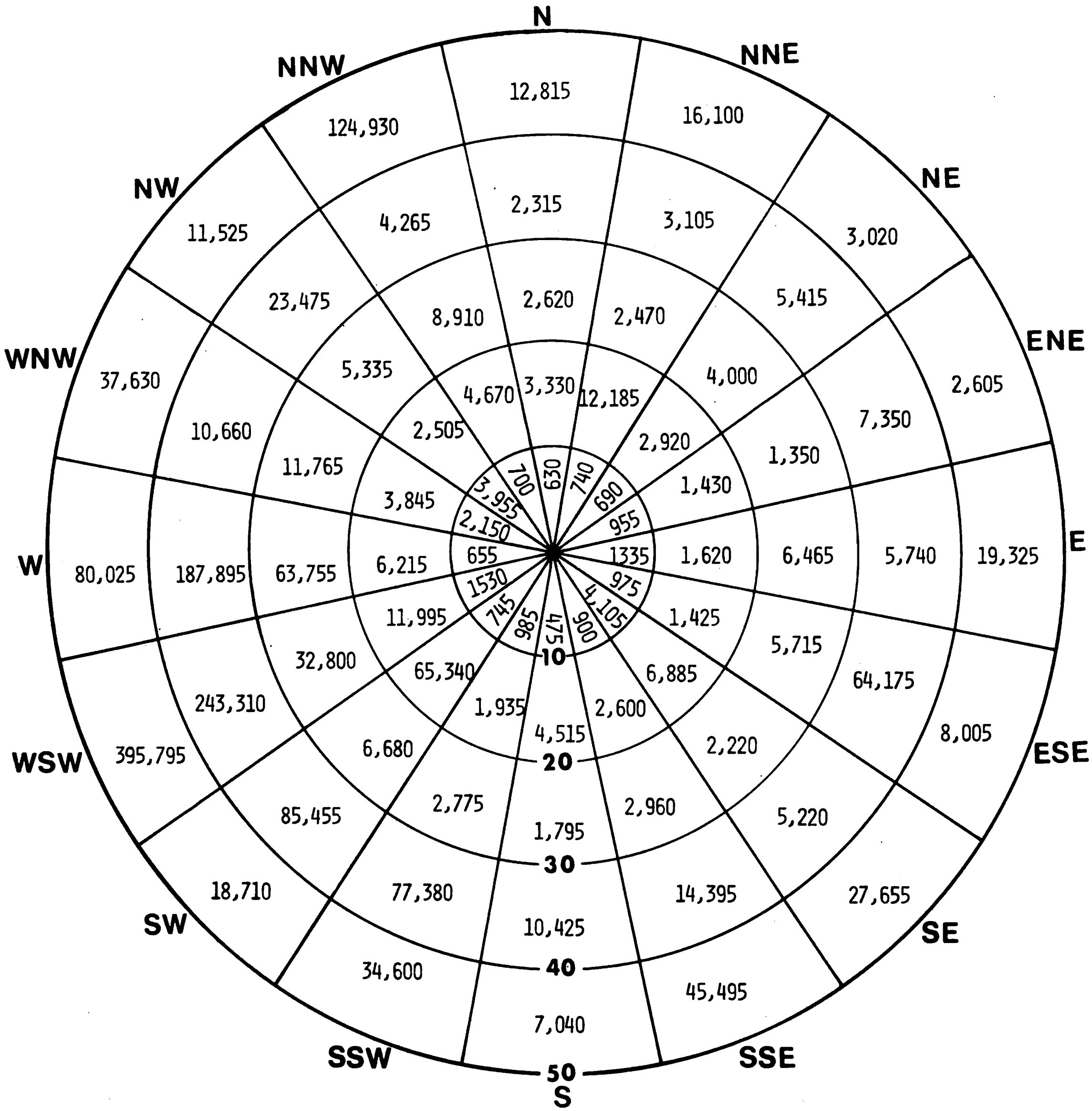


Figure 2.2-14

PROJECTED POPULATION DISTRIBUTION
WITHIN 50 MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 2020

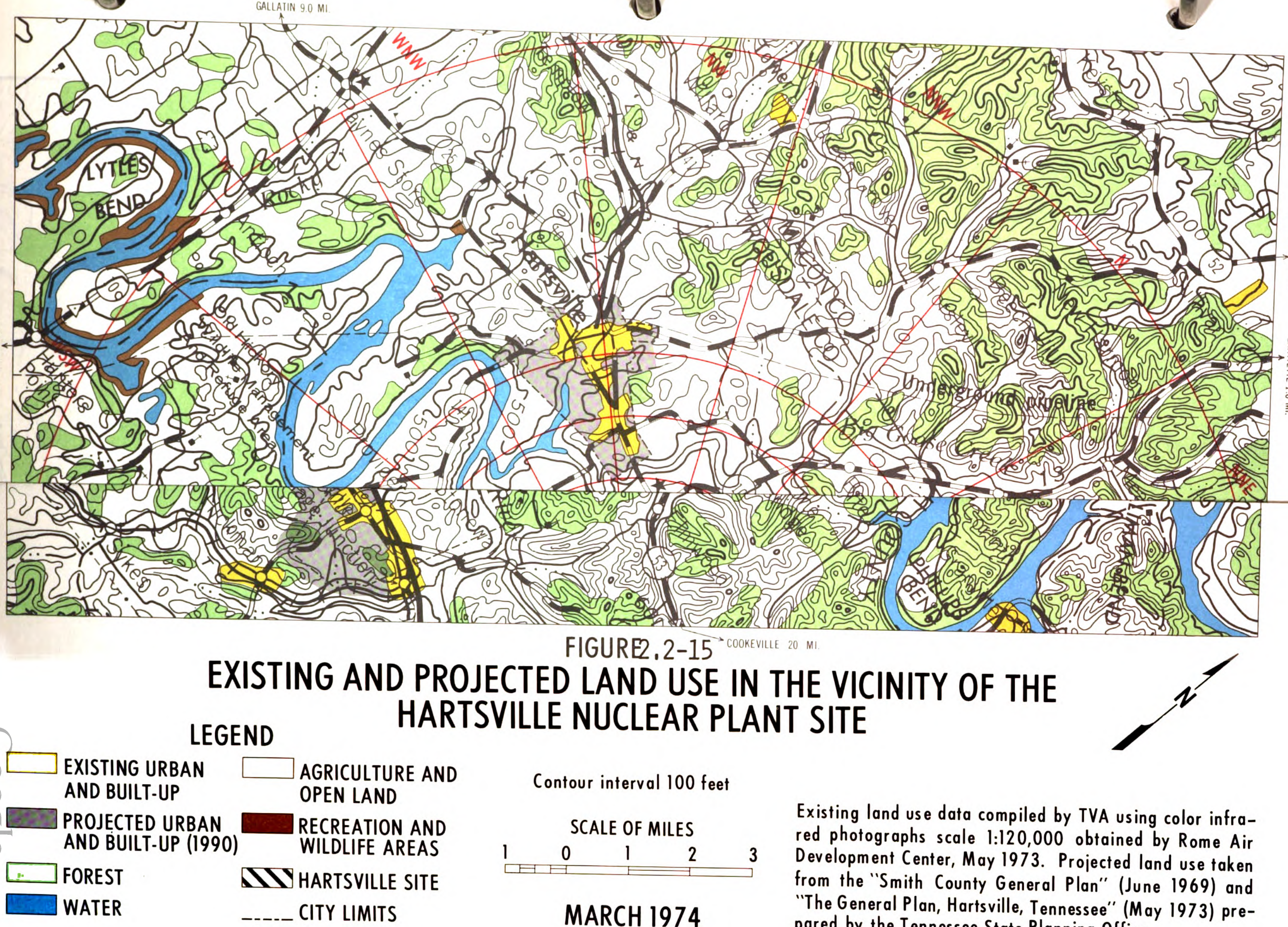


FIGURE 2.2-15

EXISTING AND PROJECTED LAND USE IN THE VICINITY OF THE HARTSVILLE NUCLEAR PLANT SITE

MARCH 1974

Existing land use data compiled by TVA using color infrared photographs scale 1:120,000 obtained by Rome Air Development Center, May 1973. Projected land use taken from the "Smith County General Plan" (June 1969) and "The General Plan, Hartsville, Tennessee" (May 1973) prepared by the Tennessee State Planning Office.

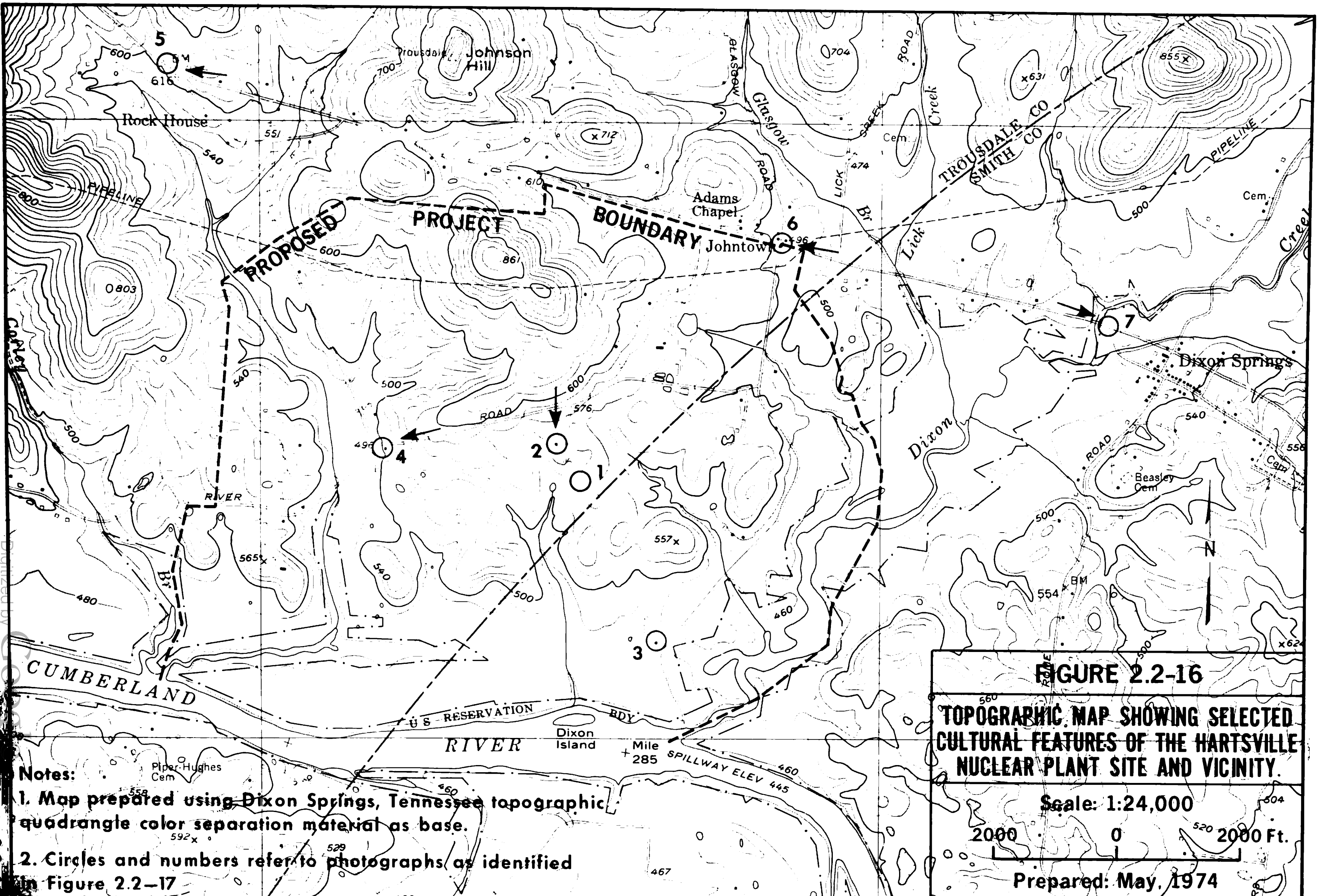


FIGURE 2.2-16

TOPOGRAPHIC MAP SHOWING SELECTED CULTURAL FEATURES OF THE HARTSVILLE NUCLEAR PLANT SITE AND VICINITY.

Scale: 1:24,000

2000 0 2000 Ft.

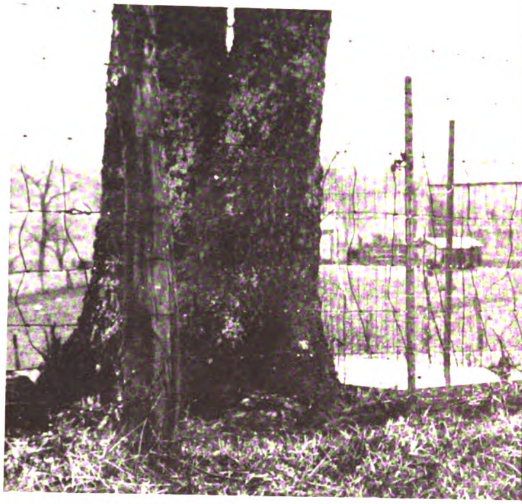
Prepared: May, 1974

Notes:

1. Map prepared using Dixon Springs, Tennessee topographic quadrangle color separation material as base.

2. Circles and numbers refer to photographs as identified in Figure 2.2–17

Figure 2.2-16



No. 1
Rev. John McGee Grav
(Gregory Farm in Backg

No. 6
Intersection Tenn. 25
and East Access Road

No. 2
Gregory Residence and

No. 7
View of Dixon Springs
From Tenn. 25 Bypass

No. 3
Early Farm Residence

Figure 2.2-17

Photographs of Structures
and Views on and Around
the Hartsville Site

SOIL ASSOCIATION AND GENERAL AGRICULTURAL SUITABILITY LEGEND - SMITH AND TROUSDALE COUNTIES, TENNESSEE

1. Mimosa - Rockland - Armour - Generally steep, cherty shallow soils, with some agriculturally well-suited rolling soils (Armour series) of the outer Central Basin. Poor for cropland and fair for pasture.

2. Dellrose - Mimosa - Rockland - Bodine - Steep, cherty shallow soils derived from phosphatic limestone and siliceous limestones of the outer Central Basin and Highland Rim. Poor for cropland or pasture uses.

3. Armour - Huntington - Lindside - Inman - Maury - Generally level to gently rolling productive bottom land and foot-slope soils along the Cumberland River, but includes some adjacent steep soils (Inman). Excellent for cropland or pasture uses.

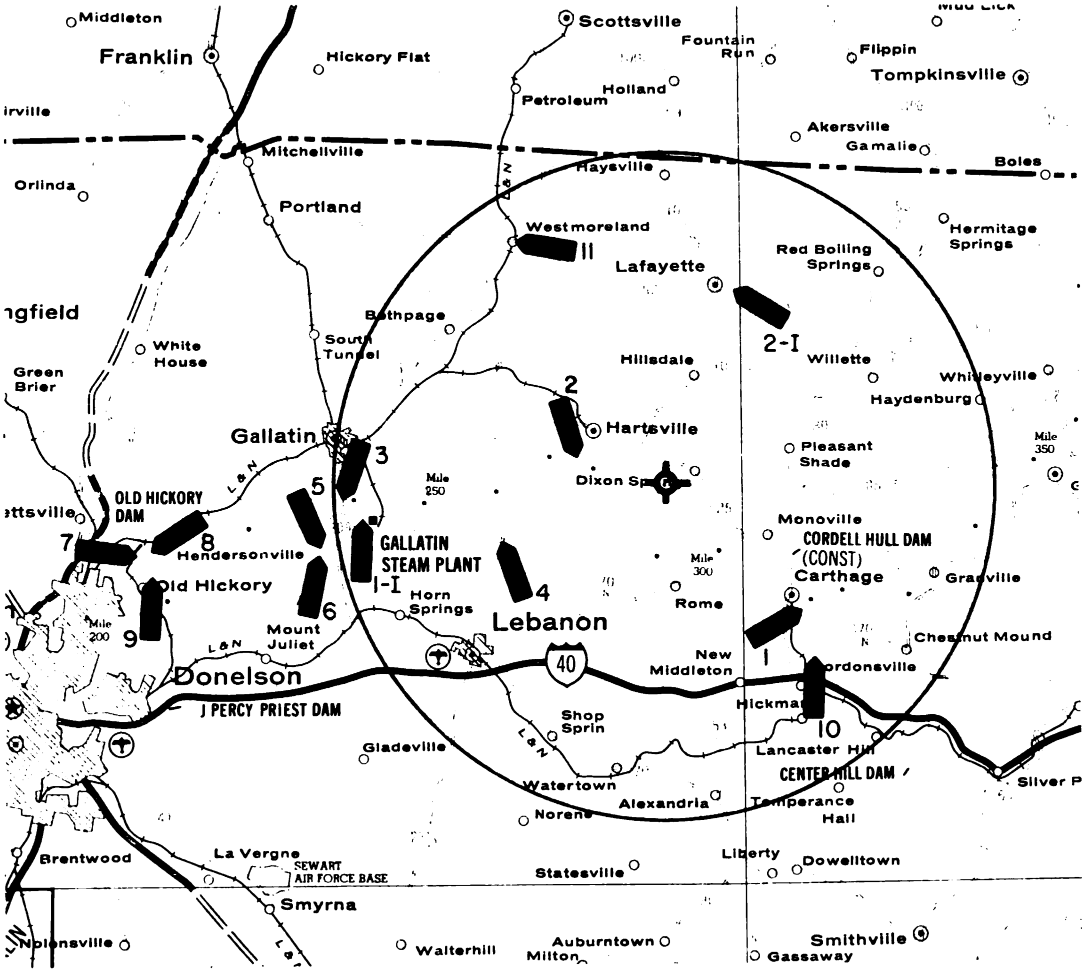
4. Talbott - Rockland - Colbert - Shallow and often rocky limestone soils of the inner Central Basin. Slopes are mainly gently rolling to steep. Poor for cropland and fair for pasture.

5. Inman - Culleoka - Hicks - Maury - Rolling to steep soils derived from phosphatic limestone, shale, and loess. Poor for cropland and fair for pasture.

6. Waynesboro - Huntington - Lindside - Level to gently rolling deep, productive soils on bottom lands and terraces along the Cumberland River. Internal drainage of these soils is well to moderately well. Excellent for cropland or pasture.

7. Maury - Armour - Braxton - Gently rolling, deep, and well-drained fertile soils derived from phosphatic limestone in the outer portion of the Central Basin. Excellent for cropland or pasture.

Figure 2.2-18 - Soil Association and General Agricultural Suitability Legend--Smith and Trousdale Counties, Tennessee. (Adapted from published County Soil Association maps, USDA Soil Conservation Service).



HARTSVILLE NUCLEAR PLANT

FIGURE 2.2-19

SURFACE WATER SUPPLIES WITHIN A 20-MILE RADIUS OF THE PLANT SITE AND SUPPLIES TAKEN FROM THE CUMBERLAND RIVER BETWEEN CORDELL HULL AND OLD HICKORY DAMS

Legend

Plant Site

Surface Water Supply

NOTE: The number associated with the type of supply corresponds to the numbering in Table 2.2-3.

Scale of Miles

10 0 10 20

2.3 Regional Historic, Scenic, Cultural, and Natural Landmarks

2.3.1 Plant Site and Environs - The plant site is located in a region of moderately rolling hills being utilized primarily as rural farm land. There are no unusual or outstanding land forms or features on the plant site, and TVA is not aware of any present use of this site which would indicate any prospective change from the present aesthetic and cultural aspects of the area related to rural farming.

2.3.1.1 Historical and Aesthetic Significance - The plant site contains no structures currently listed on the National Register of Historic Places, and no event associated with this site has had significant historic impact. John McGee, believed to have been the fourth Methodist minister to serve in Tennessee, built a house on this site prior to his death in 1837. This house still stands in good condition, although substantially altered since its original construction. Figures 2.3-1 through 2.3-5 show various views of the McGee house. Reverend McGee is buried on the grounds of his home, and his grave has been marked by the Methodist Church. TVA has acquired title to this house and grounds as a part of site acquisition.

A detailed study of the plant site and its relation to history and architecture was done by Dr. James Patrick, a consultant for TVA from the School of Architecture, The University of Tennessee, Knoxville. His report is included in this statement as Appendix K. It specifically examines the John McGee house.

In view of the consultant's report and its own investigations, TVA feels that the house does not meet the criteria for inclusion in the National Register. It is a fine example of a brick farm house of its

period, but architecturally, it is not unique. Nor is there integrity of materials and workmanship since the interior of the house has been remodeled since the death of Reverend McGee and few of the original features of the house remain to identify it with its original owner. There are other equally good examples of such architecture in the vicinity of the site. The historical relationship of this site is that associated with the activities of John McGee. The location of this house and grave are within the actual proposed construction site for the plant and therefore will have to be removed. The grave and the marble slabs which mark it will be moved to a suitable site so that appropriate recognition shall continue. While it would be physically possible to move the McGee House to another location, TVA does not believe that it warrants the public investment in funds that would be required for this purpose. The house has been photographed and measured according to standard architectural practices and a permanent record of its architecture will be placed in appropriate libraries in the state. Copies of these photos and details of the measurements are available from TVA upon request. TVA plans to demolish the house. If, however, there are groups who have an interest in this structure and would like to consider moving it intact from this site, TVA would be most willing to discuss their interest with them.

Dr. Patrick's report also discusses the Wright-Oldham house which is located on the site. TVA concurs with Dr. Patrick that the house is not architecturally significant, and its present condition would likely preclude any efforts at restoration. TVA also concurs that the house should be measured and photographed prior to any dismantling. This house is shown in Figure 2.3-6.

The Tennessee Historical Commission has informed TVA that it has considered nominating it to the National Register of Historic Places. This has not been done at this time. TVA has furnished the Tennessee Historical Commission copies of its reports of studies conducted of historic characteristics of the site. TVA officials have continued to consult with Tennessee Historical Commission officials during the planning stage of this project to assure that proper consideration is given to cultural, historical, architectural, and archaeological value. The comments of the State of Tennessee Historic Preservation Officer are included in Appendix K.

One National Register property, Dixona, shown in Figures 2.3-7 and 2.3-8, is located adjacent to the plant site on the northeast side. Part of the Dixona house dates back to before 1790. This part was built by Tilman Dixon who received the first land grant for property in this region and was one of the earliest settlers.

Dixon Springs is a relatively intact community about 1.5 miles east of the plant site with examples of structures dating from the early 19th century to the present. The State of Tennessee is considering the nomination of this community to the National Register as a historic district.

Plant construction will have no direct effect on these properties except for increased traffic and noise during construction. The completed plant will have some visual impact on Dixona and Dixon Springs because of its size and proximity of less than two miles. Figures 2.3-9 and 2.3-10 show the views respectively from Dixona and Dixon Springs toward the plant. The plant's features which will be visible from these areas have been superimposed on the photographs. To minimize this impact, TVA will work with the community and the state officials to provide, as far as practical, landscaping measures in keeping with the

community's setting. TVA will select construction alternatives to reduce this visual impact as much as practical.

Applicable requirements are being followed to determine if any other districts, sites, buildings, structures, or objects are eligible for the National Register which might be adversely affected as a result of plant construction and operation. A discussion of the external appearance of the plant is given in Section 3.1. That section also contains figures which illustrate the appearance of plant structures from various points in the area.

2.3.1.2 Archaeological Significance - The Cumberland River Valley has long been noted for its significant archaeological resources. A number of prehistoric hunters, gatherers, and horticulturists lived along its banks and terrace as long as 10,000-12,000 years ago. The dense hardwood forest supplied them a bountiful harvest of nuts and wild game while the rich alluvial plains were prime areas for growing various crops.

Archaeological surveys were initiated at the sties in September of 1972. These surveys were conducted by Dr. Major C. R. McCoullough, Assistant Research Professor, Department of Anthropology, University of Tennessee, Knoxville, and are discussed in Appendix G. Other surveys in the general area have been conducted under the direction of Mr. Steven J. Fox, Instructor of Anthropology, Motlow State Community College, Tullahoma, Tennessee.

Surveying and testing, together with a small amount of salvage excavation and investigations, were performed at the Hartsville (Johntown) site during the summer of 1973 under the direction of Dr. R. Bruce Dickson, Assistant Research Professor, Department of Anthropology, University of Tennessee, Knoxville. A preliminary report has been issued and a more comprehensive report is in preparation.

The first prehistoric occupation of the valley was probably during the Paleozoic period about 7,000 to 10,000 B.C. These people basically subsisted on a hunting and gathering economy. Numerous artifacts deposited by these people have been discovered in the valley area; and one distinguishable artifact, the "Cumberland" point, has been typed after the river. Dr. Don W. Dragoo,[1] Carnegie Museum, investigated a large Paleozoic site in the Wells Creek crater located on the confluence of Wells Creek and the Cumberland River in Stewart County, Tennessee. His report has added significant data to the understanding of these early people and the cultural development in the Cumberland River valley.

The people of the Archaic cultures dominated the river valley for thousands of years after the Paleozoic period. The main economy base of the Archaic people was hunting and gathering. On many of their habitational sites along the banks of the Cumberland River extensive shell midden deposits were accumulated. "Mussell collecting" became one of the main subsistence patterns of some Archaic cultures as evidenced by large deposits of these shells. Many of these sites were investigated along the Green River in Kentucky and the Tennessee River in the mid-1930's and into early 1940's. The Archaic culture ended about 1,000 B.C.

The density of the Woodland population in the Cumberland valley is obscure because of the relative lack of data on this culture. During the Mississippian period, however, large numbers of people occupied the banks and tributaries of the Cumberland River. One of the largest of these groups was the "Stone Box or Stone Grave" culture. These people were primarily farmers and built elaborate, fortified villages and mounds believed to be concentrated around Nashville and spreading along the Cumberland River into southern Kentucky and down into middle Tennessee. Notable mention was given to numerous earth works of this prehistoric culture in the early writings of Tennessee. A series of historical and ethrographic studies was published as early as 1897 by Gates P. Thruston[2] describing many of the physical remains and artifacts from the "Stone Box" occupation. A few Stone Box sites were excavated during the 1930's and early 1940's in conjunction with the TVA projects along the Tennessee River.

Impoundment of Old Hickory Reservoir in 1954 inundated areas along the banks of the Cumberland River and especially along the flood plains in Dixon Creek and Lick Creek, making these areas unavailable for archaeological investigation.

Over the past 200 years several other factors have adversely affected many, if not all, of the archaeological sites in the Hartsville plant site area. In the recovery of archaeological material, one of the most important aspects of the excavation is to record this material in situ. When the early settlers entered this area, they cleared the land for farming and building. Archaeological sites left barren by this

clearing became subject to gully erosion. In addition, the plowing of the fields destroyed the first 6-8 inches of any archaeological site located within the fields. This, together with sheet erosion, caused the washing of small amounts of soil from the fields each year, thus allowing the plow to reach deeper into the undisturbed areas of the site. The effect of plowing and sheet erosion affected only the latest deposits of prehistoric occupation in the plant area. Older sites may have several layers of undisturbed deposits which are still intact for scientific investigation. Other sites have been completely destroyed in the plow zone.

Plans for investigating and salvaging archaeological material are discussed in section 4.1.

2.3.2 Transmission Line Rights of Way - To connect the Hartsville Nuclear Plant into the TVA network of power distribution facilities, three transmission line corridors will be required. As shown on Figure 2.3-11, these proposed corridors will be 30 miles, 78 miles, and 86 miles in length with the right of way varying from 175 feet to 425 feet.

2.3.2.1 Historic and Cultural Significance - Corridor 1 runs west from the plant site to its intersection with an existing 500-kV transmission line approximately 5 miles west of the city limits of Gallatin. Corridor 1 begins at the plant site on the Smith-Trousdale County line and then runs west through the middle part of Trousdale County into Sumner County. The corridor passes south of

Hartsville (1970 population - 2,243) and north of Gallatin (1970 population - 13,253).

Land uses along this corridor generally consist of low-density rural development with Gallatin being the only incorporated area of major proportion. Hartsville, another incorporated area, is quite small but accounts for over half of Trousdale County's population. The area is predominately an agrarian one although pressure for suburban residential and industrial development is evident closer to Gallatin and between Gallatin and Nashville. There are no state or Federal recreation sites in the area traversed by this transmission line corridor. Old Hickory Lake does generate water-oriented recreation activity, and the area does have some historic points of interest. Historic settlements are found at Dixon Springs in Smith County and Castalian Springs in Sumner County. Historic homes like Cragfont located west of Castalian Springs, Wynnwood located at Castalian Springs, and some homes in Dixon Springs have particular historic significance. Some have been nominated to the National Register of Historic Places; others have either been donated to the state for preservation or are being preserved by various state historical societies. Corridor 1 does not encroach on any of these historic areas.

Preliminary land use plans for the year 2000 envision a continuation of present trends.[3] With the exception of higher density urban areas near Gallatin, the remaining land will continue in predominately agricultural or open space uses.

Corridor 2 runs from the generating plant southwest to the 500-kV Maury Substation, 5 miles north of Columbia. After crossing

Old Hickory Lake, this line enters Wilson County at its junction with Trousdale and Smith Counties. It passes east of Lebanon (1970 population - 12,492) and west of Watertown (1970 population - 1,061) before entering Rutherford County just south of Cedars of Lebanon State Park. The line passes between Smyrna (1970 population - 5,698) and Murfreesboro (1970 population - 26,360) then passes through Williamson County and into Maury County where it terminates north of Columbia (1970 population - 21,471).

The area traversed by this corridor is also predominately agricultural and open space uses. The three major urban centers of Lebanon, Murfreesboro, and Columbia will be subjected to increasing developmental pressures due in part to their proximity to Nashville and the completion of interstate highways close to their borders. The area around Smyrna is also projected for increasing urban-type densities.[4]

The only state park in the area is the Cedars of Lebanon State Park. Major recreation development is planned around J. Percy Priest Dam and reservoir. Corridor 2 passes well south of both recreation areas.

Corridor 3 crosses Old Hickory Lake in Smith County then runs along the Smith-Wilson County line. The corridor passes east of Watertown (1970 population - 1,061) before cutting through Wilson County into the western portion of Cannon County and the northwestern portion of Coffee County and into Bedford County. The corridor passes southeast of Bell Buckle (1970 population - 393) and Wartrace (1970 population - 616) and east of Shelbyville (1970 population - 12,262). Proceeding south into Moore County then east into Franklin County, corridor 3 passes south of Tullahoma (1970 population - 15,311) to its terminus at the 500-kV Franklin Substation south of the Arnold Engineering Development Center.

Like the areas in which the other corridors are located, the area adjacent to this line is predominately rural agricultural and open space uses. Part of the area is characterized by the rugged western rim of the Cumberland Plateau and is therefore not as likely to develop in the future. The area around Manchester is more suitable for future development and is likely to experience greater developmental pressures due in part to the completion of Interstate Highway 24.

Corridor 3 traverses no state or Federal parks; however, extensive recreation development is projected to occur around the Tims Ford Reservoir located south of the transmission line. Corridor 3 is located to the north of this proposed recreation area. In selecting the route corridors for the proposed transmission lines, the National Register of Historic Places was consulted and no historic conflicts were identified.

The Tennessee Historical Commission's search for historical sites indicated the possible conflict of corridor 3 with Fort Nash near Beech Grove and corridor 2 with two, possibly three, homes in both Maury and Williamson Counties. The exact location of Fort Nash which was built, circa 1792-93, near the junction of two major Indian trails has been difficult to pinpoint.

Consultation with the Tennessee Historical Commission will continue as the location of the corridors becomes more definite. This will ensure that any potential conflicts between their final locations and any significant historical sites will be given proper consideration.

Following the engineering survey which will provide a definitive location of the line, a professional historian will be consulted.

If it appears that any significant sites may be affected, the corridor locations will be reevaluated. The Tennessee Historical Commission will also be consulted.

2.3.2.2 Archaeological Significance - After routes for power transmission lines are established, a professional archaeologist will be consulted to determine if any archaeological resources of significance will be adversely affected by construction activities or the presence of the power transmission facilities. These investigations will be coordinated with the Division of Archaeology, Tennessee Department of Conservation. Any adverse effects which might be identified will be avoided to the fullest extent practical.

2.3.2.3 Natural Significance - The Hartsville transmission line corridors will be located within the Nashville Basin and a portion of the Highland Rim physiographic regions. The basin is 60 miles wide and 120 miles long with about 25 percent of the area in farm woodland and the remainder in pasture and crops. The central part of the basin is a gently rolling to hilly limestone plain while the outer margins bordering the Highland Rim land resource region are highly dissected with steep slopes.

The most outstanding natural vegetation community of the basin is cedar glades.[5] Cedar glades are found in areas of exposed limestone rock and very little soil. The eastern red cedar is the dominant woody species found in these areas, and many endemic herbaceous species, primarily of the mustard family, are found in the ground cover. Areas,

where soil is better developed but still very poor support hardwood glades and feature such dominant species as hackberry, winged elm, and various oaks and hickories. Glade areas support a rich spring flora but become extremely dry in summer. Patches of prickly pear are conspicuous during the hot, dry months.

Several areas of dense cedars were identified during reconnaissance of the corridors. TVA botanists will determine if any of the areas are true cedar glade communities. If such are identified, appropriate consideration will be given to their protection.

The rolling parts of the basin adjacent to the Highland Rim feature more well-formed soils and provide better site conditions for typical southern hardwood species. Yellow poplar, beech, and white oak are dominant hardwood.

The proposed transmission line corridors cross both the Harpeth River and the Duck River. A portion of the Harpeth River from the Rutherford County line northeast to the Cumberland River is designated as a wild and scenic river. Transmission line corridor 3 crosses the Harpeth River approximately 1/4 mile upstream from the designated section. a 20-mile section of the Duck River below Normandy Dam is scheduled for development as a recreation waterway. Transmission line corridor 2 traverses this section of the Duck River.

REFERENCES FOR SECTION 2.3

1. Dragoo, Don W., "Wells Creek - An Early Man Site in Stewart County, Tennessee," from Archaeology of Eastern North America, Vol. 1, No. 1, Spring 1973, pages 1-58.

2. Thurston, Gates P., Antiquities of Tennessee, Second Edition Tenase Publishing Company, Knoxville, Tennessee, reprinted 1972.

3. Preliminary Development Plan: 1972-2000 for the Mid-Cumberland Region of Tennessee, Mid-Cumberland Council of Governments and Mid-Cumberland Development District, April 1972.

4. Id.

5. Quarterman, Elsie, 1973, Tennessee's Vanishing Garden, The Tennessee Conservationist, Vol. XXXIX, No. 5, Tennessee Department of Conservation, Nashville, Tennessee.

Figure 2.3-1
"McGHEE HOUSE - NORTH VIEW"

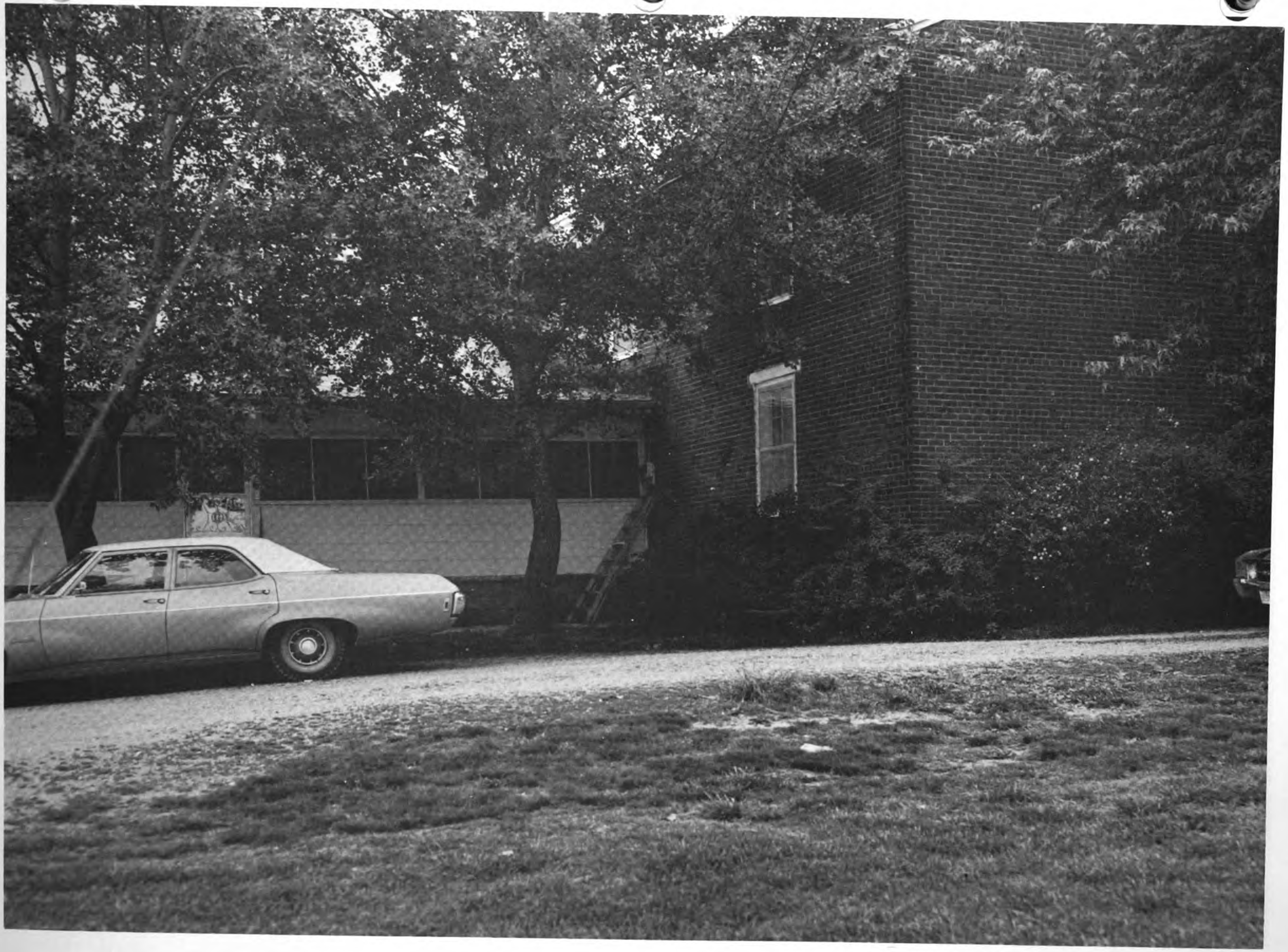


Figure 2.3-2
"McGHEE HOUSE - EAST VIEW"

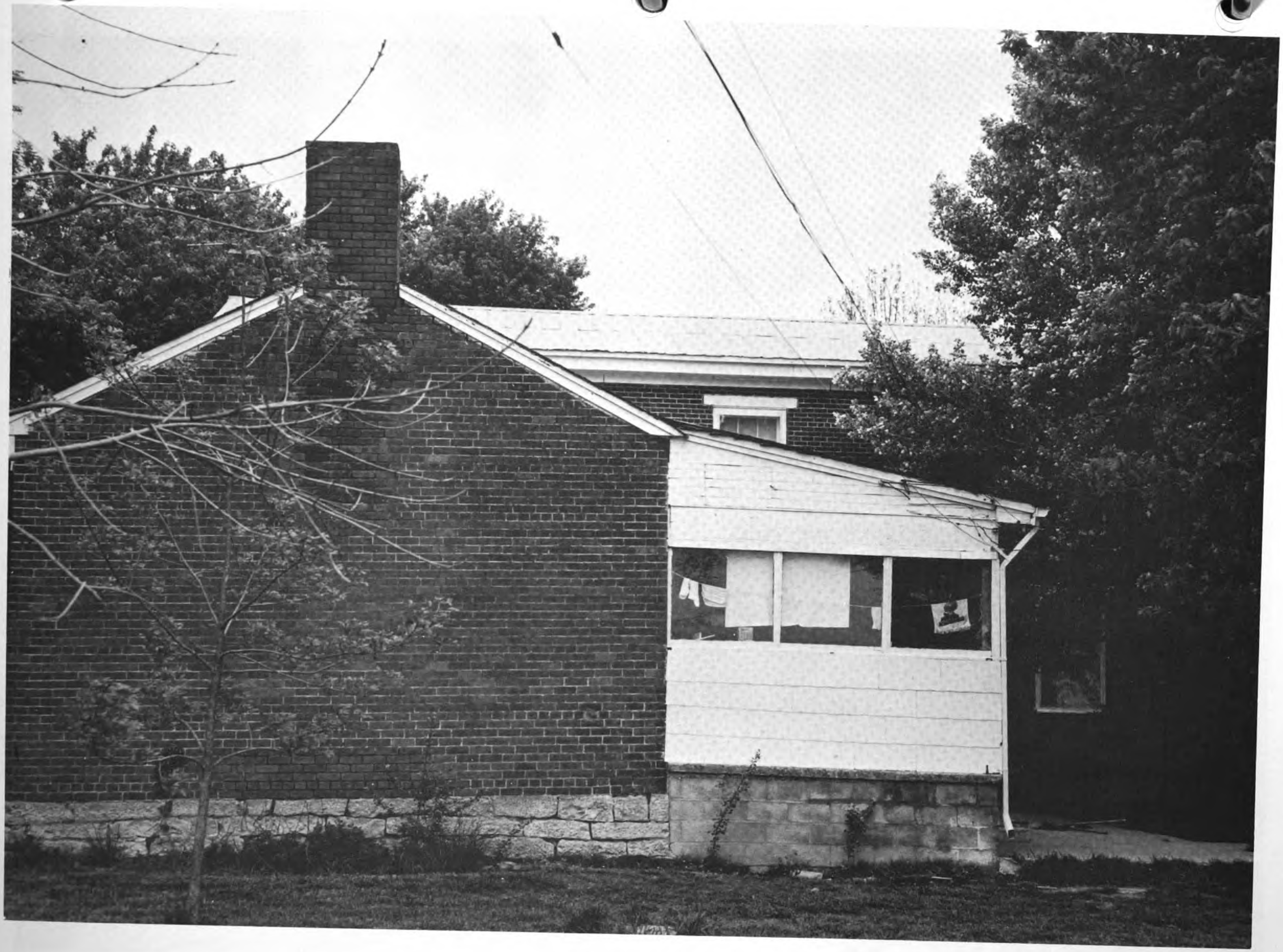


Figure 2.3-3
"McGHEE HOUSE - SOUTH VIEW"

Figure 2.3-4
"McGHEE HOUSE - WEST VIEW"

Figure 2.3-5
"McGHEE HOUSE - WEST VIEW"

Figure 2.3-6
WRIGHT-OLDHAM HOUSE

Figure 2.3-7
TILMAN DIXON HOUSE

Figure 2.3-8
TILMAN DIXON HOUSE

Figure 2.3-9

"VIEW FROM DIXONA TOWARD PLANT"

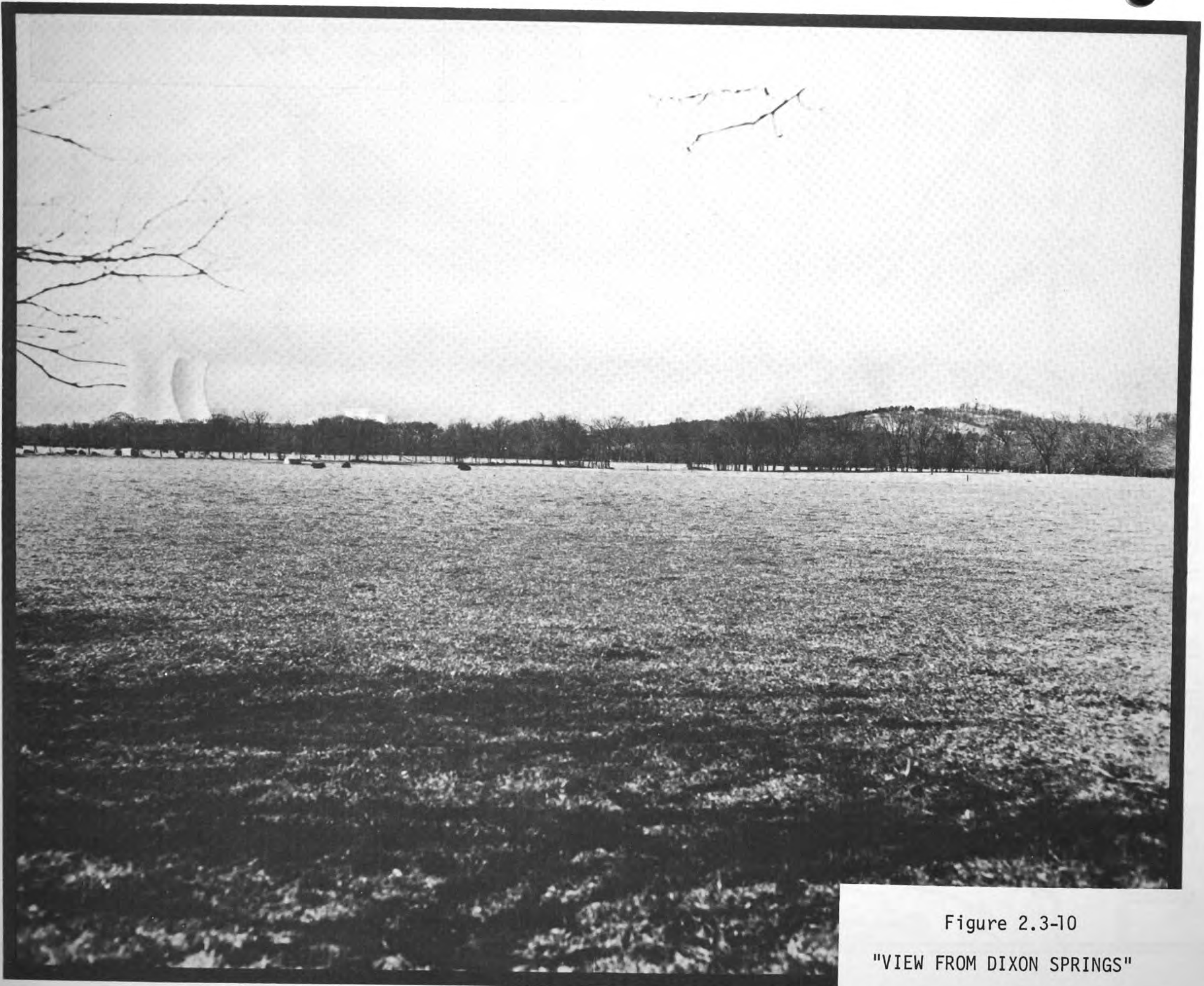
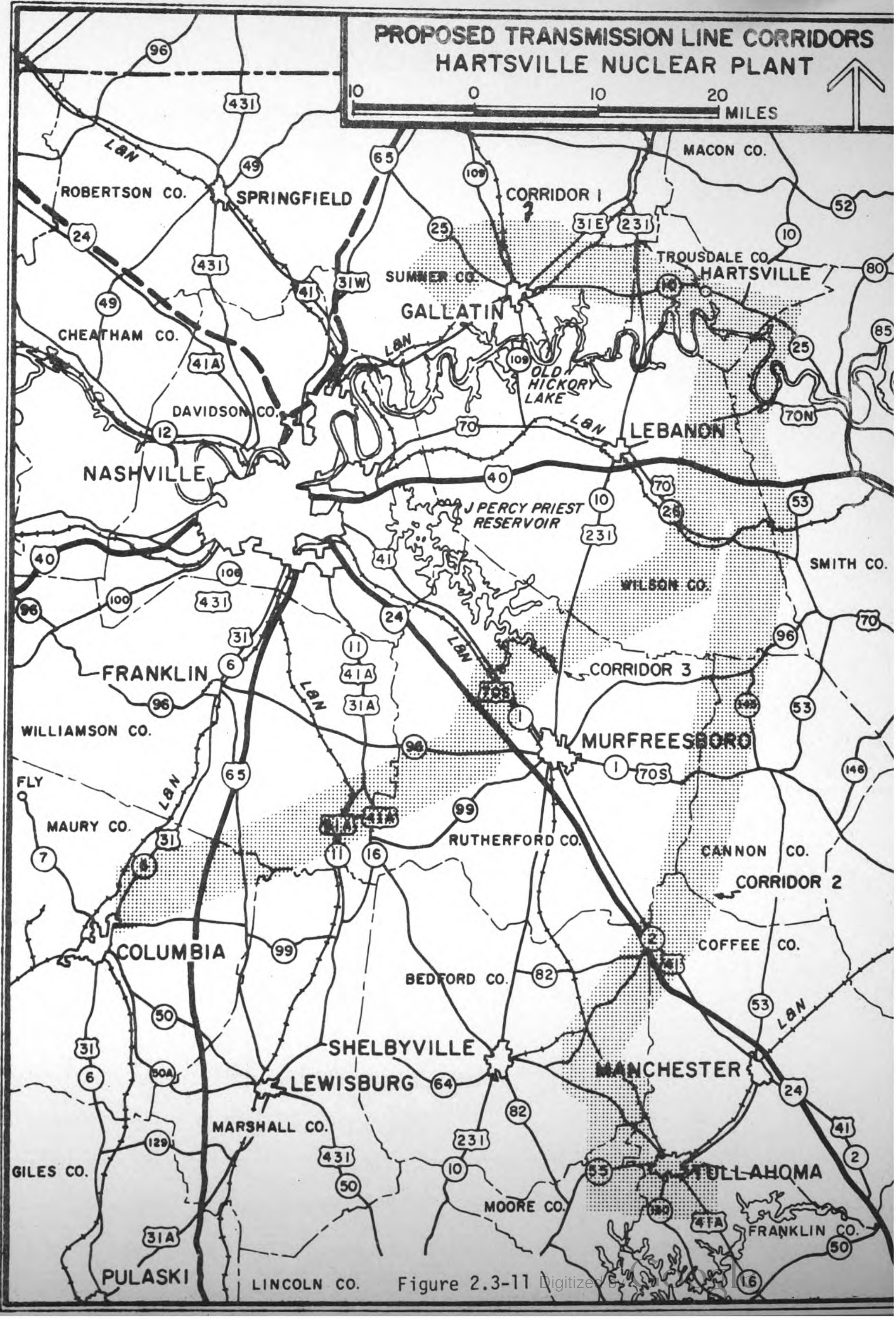


Figure 2.3-10

"VIEW FROM DIXON SPRINGS"


PROPOSED TRANSMISSION LINE CORRIDORS
HARTSVILLE NUCLEAR PLANT
10 0 10 20 MILES
MACON CO.
ROBERTSON CO.
SPRINGFIELD
CORRIDOR 1
TROUSDALE CO.
HARTSVILLE
SUMNER CO.
GALLATIN
CHEATHAM CO.
OLD HICKORY LAKE
DAVIDSON CO.
LEBANON
NASHVILLE
J PERCY PRIEST RESERVOIR
SMITH CO.
WILSON CO.
FRANKLIN
CORRIDOR 3
WILLIAMSON CO.
MURFREESBORO
FLY
MAURY CO.
RUTHERFORD CO.
CANNON CO.
CORRIDOR 2
COLUMBIA
COFFEE CO.
BEDFORD CO.
SHELBYVILLE
MANCHESTER
LEWISBURG
MARSHALL CO.
GILES CO.
TULLAHOMA
MOORE CO.
FRANKLIN CO.
PULASKI
LINCOLN CO.
L&N
Figure 2.3-11

2.4 Geology

The physiographic location of the plant site will be on the northeast flank of the Nashville Basin section of the Interior Low Plateaus Province. This elliptical basin, formed on the crest of the Nashville structural dome, occupies the central portion of the state. The erosional basin coincides closely with the structural dome and is surrounded on all sides by the Highland Rim. In the vicinity of the Hartsville site, the rate of erosion and consequent topography have been controlled largely by the Cumberland River. Approximately 425 feet of relief are now present between the floodplain and the tops of hills to the north and east of the site.

Lithologically, the Nashville Basin and surrounding Highland Rim are composed of Ordovician to Mississippian rocks - limestone, shale, and sandstone - typical of the region and lying in normal stratigraphic sequence. Only two formations of Ordovician age will be involved in plant construction; a maximum 40 feet of the Hermitage Formation and the Carters Limestone with a total stratigraphic thickness of 139 feet. Foundation investigations were started in the fall of 1971 and have continued intermittently through the winter of 1974. In the process, an area 3,400 feet by 4,500 feet has been thoroughly investigated with more than 400 drill holes. Nine permanent groundwater observation holes were completed in August 1972.

Topography at the site is low and rolling with the exception of a ridge immediately to the north which rises some 300 feet higher. Except for the isolated knolls, the general elevation of the land surface slopes

gently toward the river to the south. The surface above approximate elevation 470 is covered to an average depth of 12 feet with residual clay derived from the Hermitage Formation. Depths of alluvial soils in the floodplain area have not yet been determined because of lack of permission for access.

As previously stated, rock at the site will be composed of two basic formations forming a very shallow syncline plunging to the south with a dip of approximately one degree. The upper unit is the Hermitage Formation, a thin-bedded to laminated, sandy and argillaceous limestone with shale. Thickness varies from 0 to 40 feet depending on surface elevation. Lying unconformably beneath the Hermitage is the Carters Limestone, a medium to fine-grained, thin- to thick-bedded limestone with shaly partings. The total thickness of the Carters in this area approximates 139 feet. Within the upper zone, at about 25 feet below the unconformity is a 0.6 to 0.8 foot meta-bentonite horizon consisting of a weakly cemented, granular, siliceous material and some plastic clay.

Differences in lithologic character between the Hermitage Formation and the Carters Limestone, as well as the T-3 meta-bentonite and other key horizons, are such that excellent structural interpretation is possible. Because of these characteristics and the results of the extensive drilling program, it has been ascertained that there is no active or capable fault within the vicinity of the major plant structures. Also, the 1966 Geologic Map of Tennessee, published by the Tennessee Division of Geology, does not indicate any faulting within a 10 mile radius of the plant.

Permeability of the rock cannot be measured in common terms. It can be said that movement of the groundwater is controlled completely by bedding plane and joint openings. The frequency of these structural representations is very low in the Hermitage Formation, whereas the upper portion of the Carters Limestone may contain a substantial number, especially where the overlying Hermitage is very thin.

Reference to the various subsections on groundwater will identify the fact that there is no piezometric surface. Levels vary substantially depending upon lithology, structural features and intensity of weathering. Construction of the plant therefore, will have no effect on groundwater more than a few hundred feet beyond the work area; and consequently, no effects will occur beyond the exclusion radius for the site.

The rock underlying the site is fully competent to sustain the anticipated design loads of the plant.

2.5 Hydrology

2.5.1 Surface Water Hydrology

2.5.1.1 Physical Properties - The proposed nuclear generating plant is to be located on the right bank of the Cumberland River at approximately Cumberland River Mile (CRM) 285. Old Hickory Dam is located at CRM 216.2. The water elevation within Old Hickory Reservoir normally varies from elevation 442 (MSL) in the winter to 445 (MSL) in the summer. At normal maximum pool (elevation 445), the reservoir impounds a volume of 420,000 acre-feet, with a surface area of 22,500 acres. Water depths range from 60 feet at Old Hickory Dam to about 30 feet at the Hartsville site and to shallower depths further upstream. Stream widths vary from 1/2 to 1 mile near Old Hickory Dam to less than 1,000 feet at the Hartsville site.

The natural temperatures in Old Hickory Reservoir at river mile 285 are primarily influenced by the temperature of water released from Cordell Hull (CRM 313.5) and Center Hill (mile 26.6 Caney Fork) Dams. Water temperature records demonstrate that the reservoir is partially stratified.

A comparison of temperatures at the Cordell Hull tailwater and several other points on Old Hickory Reservoir with the Gallatin Steam Plant intake temperatures indicates that little change occurs in the water temperature as the water flows from Hartsville to Gallatin. For this reason, the Gallatin Steam Plant (CRM 244.0) intake temperatures were used to provide a detailed record of temperature conditions at the

Hartsville site. Appendix B1 provides a more detailed discussion of the natural hydrodynamic and thermal regimes of the Old Hickory Reservoir. The Gallatin Steam Plant intake temperatures are plotted as weekly averages in Figure B1-9 and tabulated as daily averages in Tables B1-2 through B1-8. As demonstrated by these tables, the changes in water temperatures are primarily seasonal.

Water quality measurements made at sampling stations at river miles 308.25, 287.7, 263.0, and 244.0 indicate that concentrations of suspended and dissolved solids are well below limits set in the state water quality standards (see Tables 2.5-1 through 2.5-4 and Appendix B3).

2.5.1.2 Chemical Properties - The Cumberland River at the proposed plant site is a source of suitable water with relatively consistent chemical properties. Analysis of Table 2.5-5 shows that the average trace metal concentrations of most samples taken at the Cordell Hull Dam tailrace at CRM 313.5 meet Tennessee Water Quality Control Board Stream Guidelines. Concentrations of iron and manganese do not meet guidelines for domestic water supply. This high manganese concentration may be a result of the recent closing of Cordell Hull Dam and consequently may be only a temporary problem. The absence of large quantities of industrial and municipal wastewater effluents in the Cumberland River above the plant site results in high quality water. Table 2.5-6 lists upstream industrial and municipal waste discharges between Cordell Hull Dam and the plant site. These effluents are very small when compared with flow in the river.

2.5.1.3 Sanitary Engineering Aspects of Surface Water Quality - Measurements of fecal and total coliform bacteria, biochemical oxygen demand, and chemical oxygen demand at Cumberland River miles 244.0, 263, and 308.25 indicate that the river is a suitable source of water for the proposed plant. The results of sampling at these three locations are presented in Tables 2.5-7, 2.5-8, and 2.5-9.

Analysis of data taken at river miles 244.0 and 263 in 1973 shows that values for fecal coliform and 5-day BOD are below detectable limits, and values for COD are less than 10 mg/l. These low values indicate that the upstream waste dischargers (Table 2.5-6) have little effect on water quality in the area of the site. Analysis of data taken at river mile 308.25 in 1958-1960 and 1972-1973 shows that generally 5-day BOD values are less than 2 mg/l, and fecal coliform values are well within state water quality standards, with the highest value reported being 490 per 100 ml.

In summary, the data taken in the vicinity of the site indicates that the sanitary-chemical and bacteriological quality of the water is good.

2.5.1.4 Hydrological Properties

Site Location - The Hartsville plant site is located on the north shore of Old Hickory Reservoir at Cumberland River Mile 285, approximately 10 miles northwest of Carthage, Tennessee. Drainage area of the Cumberland River at the site is 10,903 square miles. The Cumberland River is formed in the rugged Cumberland Mountains by the confluence of Poor Fork and Clover Fork at Harlan, Kentucky, about 160

miles northeast of Hartsville. Elevation in the headwaters ranges up to over 4,000 feet. The stream flows generally in a southwesterly direction.

Tributaries - The largest tributary of the Cumberland River is the Caney Fork River which enters the Cumberland River at mile 309.2 and drains an area of 2,586 square miles. Other major tributaries above the Hartsville site are the South Fork Cumberland River, which has a drainage area of 1,382 square miles and enters from the southeast at mile 516.0; the Obed River which enters from the southeast at mile 380.9 with a drainage area of 947 square miles; and the Rockcastle River which enters from the north at mile 546.4 and drains 763 square miles. Below the Hartsville site, major tributaries include Red River, which enters the Cumberland River from the northeast at mile 125.3 and drains 1,456 square miles; Harpeth River; and Stones River. Harpeth River and Stones River both enter the Cumberland River from the southeast at miles 152.9 and 205.8, respectively. The drainage area of the Harpeth River is 866 square miles and the Stones River is 936 square miles.

In the immediate vicinity of the Hartsville site, Dixon Creek enters the Cumberland River from the north at mile 285 and drains 27.4 square miles. Other nearby minor tributaries include Round Lick Creek, which enters from the south at mile 292.4 and drains 85.5 square miles; and Goose Creek, which enters from the north at mile 280.1 and drains 107 square miles. During periods of drought the minor tributaries experience extreme low flow and many go completely dry.

Streamflow - The flows through Old Hickory Reservoir are controlled by releases from Old Hickory Dam and Cordell Hull Dam on the Cumberland River and by Center Hill Dam on the Caney Fork River which joins the Cumberland at mile 309 just downstream from Cordell Hull. The

total flows from Cordell Hull and Center Hill are recorded by a gage at Carthage, Tennessee (CRM 308). Figure B1-1 shows the frequency of the mean daily discharges at Carthage based upon records obtained before closure of Cordell Hull.[1] However, because Cordell Hull has only limited storage within its normal headwater range at any time of year, the daily average flow frequencies at Carthage will be essentially unchanged by the closure and operation of Cordell Hull. Low-flow frequencies for the Cumberland River at Carthage are shown on Figure B1-2.[2] An average daily flow of less than 1/4 the mean daily flow may occur for up to 30 days during a 30-year period.

All of the dams controlling releases into or out of Old Hickory Reservoir are operated for power generation, flood control, navigation, and recreation. Thus, except during flood periods, the releases are made through turbines according to a schedule dictated by the need for peak power. Such operation results in hourly variations of river flows within the reservoir such that the flow at any time during a day may vary significantly from the daily average flow. For example, it is estimated that during extended (several weeks) periods of low average flow, releases from all of the three hydro plants will be made only 10 hours each weekday, 5-10 hours on one of the weekend days, and no releases will be made on the other weekend day. These transient flows significantly affect the temperature distribution within the reservoir as discussed in the following sections. Appendix B2 defines typical transient low flows at the proposed Hartsville Nuclear Plant site, due to hydropower operations of Cordell Hull, Center Hill, and Old Hickory Dams.

For the mean daily flow at the site (17,000 ft^3/s), as indicated by the stream gauge at Carthage, Tennessee, the flow velocity will be approximately 1.0 ft/s based on a cross section taken at CRM 285.13. The natural minimum flow past the site is estimated at about 100 ft^3/s. This would have occurred during extreme drought conditions in the fall of 1925 had there been no regulations of the Cumberland at that time.

A model has been used to estimate the minimum transit time and the minimum dilution of a postulated slug release.

Table 2.5-10 lists all water users between the site and Old Hickory Dam, minimum dilution factors in the river reach between the plant site and respective intakes, and the transit times between the site and the water intakes. Average transport times and average riverflows are given in Table 2.5-11.

Assumptions used in these calculations are the following:

1. Concentration and dilution calculations have been made for a postulated slug release.

2. The calculations of reservoir transit time are based on the assumption of normal pool elevation of 445.0 feet, and flow is 40,000 cfs, which is the maximum flow through the turbines at the two upstream dams.

3. Any slug release will be spilled into the blowdown water system and mixed into the river in rather uniform concentration over the entire cross section of the reservoir.

4. The slug is dispersed longitudinally as it moves downstream because of velocity variation in the cross section of the reservoir.

5. The advance nose of the slug arrives at downstream locations at times computed from the simple, well-established hydraulic relationship: Maximum velocity in the cross section = 1.175 times the mean velocity.

6. The longitudinal distribution downstream from the point of release follows a distribution very similar to the shape of a normal frequency curve. This fact has been established by hundreds of observations on dye releases, salt releases, etc. in natural streams.

7. The transit time calculations are based on power flow studies performed by the U.S. Army Corps of Engineers.

Water Levels in Reservoirs - Water levels at the Hartsville site depend upon the operation of the Cumberland River Basin reservoir system. The system is operated primarily for navigation, power, and flood-control purposes, and water levels may have little or no relation to flow in the river. Since the initial impoundment of Old Hickory Reservoir, minimum reservoir elevation at the Hartsville site is estimated at 442 feet and occurred on October 22, 1957, and October 28, 1969, while the maximum reservoir elevation is estimated at 463 feet and occurred on March 1, 1962.

2.5.2 Ground Water

2.5.2.1 Physical Characteristics - The Hartsville site is located near the northern edge of the Central Basin, which is underlain by nearly horizontal limestone strata. Near-surface geologic formations at the site belong to the Stones River Group and the Nashville Group of Middle Ordovician age. These limestone formations are generally poorly water bearing, largely because of the presence of shale beds, shale partings, and shaly limestone. Their ability to receive, store, and transmit water is low.

The youngest formation underlying the site is the Hermitage Formation, a shaly limestone in which large, extensively

interconnected openings are not common. The underlying Carters Limestone and Lebanon Limestone are more soluble and contain more water-bearing openings than the Hermitage.

2.5.2.2 Ground Water - Chemical Parameters - No ground-water quality data for the Hartsville site are yet available, but results of ground-water quality analyses by the Tennessee Division of Water Resources[3] for wells in Trousdale and Smith Counties can be assumed to be representative of the Hartsville site, since the stratigraphy for the site is similar to that of the remainder of this part of the northeastern Central Basin of Tennessee.

Ground-Water Quality in

Trousdale and Smith Counties, Tennessee

	Fe mg/l	SO_4 mg/l	Cl mg/l	Total Hardness as $CaCo_3$ mg/l	Total Dissolved Solids mg/l	pH	Temp. °C
Trousdale:							
Average	.14	76	60	291	498	7.1	13
Maximum	.25	150	163	390	831	7.7	19
Minimum	.05	28	25	210	348	6.7	5
Smith:							
Average	.14	42	90	252	530	7.2	15
Maximum	.73	210	750	999	1,096	9.0	18
Minimum	.00	8	5	50	209	5.5	9

Ground water of the area is of the calcium bicarbonate type, is hard to very hard, and fairly high to high in total dissolved solids content. The frequency of occurrence of water containing noticeable hydrogen sulfide in Trousdale County is 17 percent, a frequency exceeded in only two other counties in Tennessee.[3]

Ground-water quality largely reflects the lithology through which the water moves and the duration of time of contact with soluble minerals. In this area, lithology consists mainly of shaly limestone and calcareous shale, through which the water moves slowly because of low rock permeability.

Ground-water quality at the Hartsville site will be determined by analyzing samples of water from nine onsite observation wells. Analyses will include determination of background radioactivity.

2.5.2.3 Ground Water - Hydrologic Characteristics - Ground water at the Hartsville site occurs under shallow unconfined conditions, in openings formed along fractures and bedding planes. Most of the openings have been enlarged by solution to some extent; some are of large size. Many are partly or completely filled by residual clay.

Results of water-level measurements in a large number of foundation exploration holes, made in May 1972, show that water levels vary with well depths. Wells a few feet apart may show a difference of several feet in depth to water. The reason for this is believed to be that vertical permeability is less than horizontal permeability. Areally inconsistent water levels are typical of rocks of low permeability. The water table does in general conform to topographic configuration, and has a gradient of about .05 from the site to Old Hickory Lake.

Generalized water-table maps, based on measurements made in nine onsite observation wells, are shown in Figure 2.5-1 for March 1972 during the period of high-water levels, and for October 1972 during the period of low-water levels. Table 2.5-12 lists results of monthly measurements of water levels in the observation wells, locations of which are shown in figure 2.5-1, between January 1973 and November 1973. Table 2.5-13 is the well and spring inventory within a two-mile radius of the plant site as measured in February 1974. Locations of these wells are shown on Figure 2.5-2.

Overburden thickness at the site ranges from less than 10 feet to more than 70 feet and averages about 20 feet. Over most of the site area the water table is below the top of bedrock, so that overburden has little effect on ground-water storage. Average bedrock porosity, estimated on the basis of cavity openings penetrated by several thousand feet of foundation exploration holes, is about two percent above an elevation of 350 feet. Below elevation 350 feet, porosity is even lower. The low permeability and transmissivity of these rocks are reflected in well yield statistics for Trousdale County, where the average well yield is reported to be 8 gallons per minute and the maximum reported yield is only 50 gallons per minute.

Using the estimated porosity of two percent above elevation 350 feet, the volume of ground water stored beneath a strip 1,000 feet wide and extending from the plant site to Old Hickory Lake is about 15 million cubic feet.

2.5.3 Water Quality Standards - Under the provisions of section 401 (a)(6) of the Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. & 1341 (a)(6) (Supp. II, 1972), TVA as a Federal Agency is not required to obtain the certification of compliance with applicable state water quality standards required by section 401 (a) of that Act. TVA is, however, required by section 313 to meet state water quality requirements and is subject to Executive Order 11752, "Prevention, Control, and Abatement of Environmental Pollution at Federal Facilities." The "General Water Quality Criteria for the Definition and Control of Pollution in the Waters of Tennessee", established by the Tennessee Water Quality Control Board, is included in Appendix B-3.

References for 2.5

1. USGS Gage at Carthage, Tennessee (1951-1970).

2. Nashville District, Corps of Engineers, Ref. ORNED-14, September 1964.

3. Wilson, J. M., M. J. Mallory, and J. M. Kernodle, Summary of Ground-Water Data for Tennessee through May 1972, Tennessee Division Water Resources Misc. Pub. No. 9, 1972.

Table 2.5-1

CHEMICAL QUALITY OBSERVATIONS ON THE CUMBERLAND RIVER AT THE HARTSVILLE WATERWORKS INTAKE AT CRM 278.7

Water Years 1960-1966

Water Year	Average Discharge	Hardness as $CaCO_3$	Calcium as $CaCO_3$	Magnesium as $CaCO_3$	Sodium	Potassium	Iron	Chlorides	Sulfates	Dissolved Solids
	cfs	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
1960	17,630	72	46	25	2.0	1.3	1.2	3.4	13	93
1961	24,050	87	49	38	2.3	1.2	1.6	4.6	13	81
1962	15,570	75	51	24	2.3	1.3	1.3	5.0	13	90
1963	12,860	83	54	30	2.1	1.5	2.4	5.0	14	76
1964	18,300	86	60	26	2.7	1.6	3.2	4.0	14	88
1965	9,780	92	63	29	3.0	1.4	1.9	3.0	16	85
1966	19,340	84	61	23	3.2	1.4	2.6	4.0	24	101

SOURCE: "Water Quality of Tennessee Surface Streams (1960-1967)," Tennessee Stream Pollution Control Board

TABLE 2.5-2

FIELD MEASUREMENTS OF CUMBERLAND RIVER QUALITY AT CRM 308.25

Date	Water Temp.	Dissolved Oxygen	Total Alkalinity as $CaCO_3$	pH	Total Hardness as $CaCO_3$	Color Pt-Co	Turbidity	Total Solids	Discharge
	°C.	mg/l	mg/l		mg/l	Units	JTU	mg/l	ft^3/s
8/ 7/72	17.0	9.1	46	7.6	66	10	15.0	102	11,200
9/ 5/72	16.0	8.7	42	7.5	58	10	17.0	81	6,940
10/ 5/72	15.0	8.2	60	7.6	78	14	9.0	100	6,710
11/ 3/72	15.0	9.5	60	7.4	80	5	4.0	111	10,400
2/ 9/73	--	7.5	34	7.4	76	41	18.0	140	46,600
3/ 5/73	8.0	11.6	--	7.4	64	52	25.0	124	12,500
5/14/73	13.5	10.9	54	7.7	69	78	48.0	100	30,700
6/ 5/73	18.0	9.7	62	7.6	76	36	18.0	103	--
7/30/73	20.0	8.9	49	7.4	63	57	24.0	110	--
9/11/73	19.0	5.7	46	6.6	64	<1	13.0	111	--
12/ 2/58	10.0	9.9	70	7.4	79	11	15.0	134	5,860
1/21/59	7.0	10.8	69	7.3	62	14	35.0	146	15,200
2/ 3/59	8.0	11.1	74	7.2	51	11	10.0	140	8,520
3/24/59	11.0	10.9	58	7.5	86	25	14.0	128	10,100
6/14/60	18.0	9.4	45	7.5	80	5	10.0	125	6,510
9/13/60	17.0	8.9	44	7.5	77	35	12.0	105	5,980

SOURCE: State of Tennessee, Water Quality Control Division, and "Water Quality of Tennessee Surface Streams (1960-1964)," Tennessee Stream Pollution Control Board

Table 2.5-3

FIELD MEASUREMENTS OF CUMBERLAND RIVER QUALITY AT CRM 263

Date	Depth of Measurement	Water Temp.	Dissolved Oxygen	Total Alkalinity as $CaCO_3$	pH	Total Hardness as $CaCO_3$	Color	Turbidity	Solids
	ft.	°C	mg/1	mg/1		mg/1	PCU	JTU	mg/1
5-22-73	1	15.5	10.9	43	7.2	66	10	15	111
5-22-73	19	15.5	10.6	47	7.2	63	10	20	108
5-22-73	38	15.5	11.2	46	7.4	63	10	40	153
7-23-73	0	19.7	7.4	40	6.7	61	15	20	101
9- 4-73	1	22.0	7.4	42	6.5	58	20	15	86

SOURCE: Tennessee Valley Authority, Water Quality Branch

TABLE 2.5-4

FIELD MEASUREMENTS OF CUMBERLAND RIVER
QUALITY AT CRM 244.0

Date	Water Temp.	Dissolved Oxygen	Total Alkalinity as $CaCO_3$	pH	Total Hardness as $CaCO_3$	Color	Turbidity	Total Solids
	^oC.	mg/l	mg/l		mg/l	PCU	JTU	mg/l
5/22/73	17.5	10.5	45	6.7	67	10	15	119
7/23/73	20.3	8.6	38	6.8	64	15	15	105
9/ 5/73	22.0	7.0	34	6.8	56	10	15	114

SOURCE: Tennessee Valley Authority, Water Quality Branch

TABLE 2.5-5

SUMMARY OF OBSERVED TRACE METAL CONCENTRATIONS AND COMPARISON WITH TENNESSEE WATER QUALITY CONTROL BOARD GUIDELINES

Parameter Total	Observed Concentrations at CRM 313.5 May-September 1973			Tennessee Water Quality Control Board Stream Guidelines
	Maximum	Minimum	Mean	
	μg/l	μg/l	μg/l	μg/l
Iron	1,000.0	600.0	830.0	1,500 300a/
Copper	<10.0	<10.0	<10.0	20
Zinc	20.0	<10.0	13.0	100
Barium	<100.0	<100.0	<100.0	5,000 1,000a/
Beryllium	<10.0	<10.0	<10.0	No guideline established
Silver	<10.0	<10.0	<10.0	5
Aluminum	1,600.0	400.0	970.0	1,000
Selenium	<1.0	<1.0	<1.0	10
Arsenic	<5.0	<5.0	<5.0	1,000 10a/
Manganese	120.0	50.0	90.0	1,000 50a/
Lead	<10.0	<10.0	<10.0	50
Chromium	<5.0	<5.0	<5.0	50
Nickel	<50.0	<50.0	<50.0	100
Cadmium	<1.0	<1.0	<1.0	10
Mercury	0.6	<0.2	0.3	5

a. Guideline for streams classified for domestic water supply.

SOURCE: Tennessee Valley Authority, Water Quality Branch

Table 2.5-6

WASTE DISCHARGES BETWEEN CORDELL HULL DAM ON THE CUMBERLAND RIVER AND CENTER HILL DAM ON THE CANEY FORK RIVER AND THE HARTSVILLE NUCLEAR PLANT SITE

Name of Discharger	Point Discharge	Discharge
Domestic	River Mile	MGD
1. City of Carthage	CRM 308.2	0.33
2. Cordell Hull Dam	CRM 313.5	0.004
3. I-40 Rest Area	CFRM 19.5	0.02
Industrial		
1. Wm. L. Burnell Co.	CFRM 8.5	0.144
2. New Jersey Zinc Co., (Elmwood Mine)	CFRM 4.3	0.096

Note: Domestic waste discharges receive secondary treatment or its equivalent. Industrial discharges receive treatment which depends upon the characteristics of the waste.

SOURCE: Interview with Bob Slayden, State of Tennessee, Water Quality Control Division.

Table 2.5-7

Field Measurements of Cumberland River
Quality at CRM 244.0

Date	BOD 5-Day mg/l	Fecal mg/l	Total mg/l	COD mg/l	Discharge cfs
5/22/73	<1.0	<10	<10	2	
7/23/73	<1.0	<10	20	5	
9/5/73	<1.0	<10	<10	4	

Table 2.5-8

Field Measurements of Cumberland River
Quality at CRM 263 ±

Date	Depth	BOD 5-Day	Coliform Fecal	Coliform Total	COD	Discharge
	ft.	mg/l	mg/l	mg/l	mg/l	cfs
5/22/73	1	<1.0	<10	1,820	10	
5/22/73	19	<1.0	<10	30	6	
5/22/73	38	<1.0	<10	20	6	
7/23/73	0	<1.0	<10	20	4	
9/4/73	1	<1.0	<10	<10	3	

SOURCE: Tennessee Valley Authority, Water Quality Branch.

Table 2.5-9

Field Measurements of Cumberland River Quality at CRM 308.25

Date	BOD 5-Day	Coliform Fecal	Coliform Total	COD	Discharge
	mg/l	mg/l	mg/l	mg/l	cfs
8/ 7/72	1.4	-	-	-	11,200
9/ 5/72	1.7	34	50	-	6,940
10/ 5/72	1.2	164	1,800	-	6,710
11/ 3/72	0.6	54	350	-	10,400
2/ 9/73	12.5	-	-	2	46,600
3/ 5/73	1.0	260	460	-	12,500
5/14/73	1.0	80	5,000	-	30,700
6/ 5/73	1.0	54	330	-	-
7/30/73	1.2	370	1,110	-	-
9/11/73	0.4	490	1,250	-	-
10/ 3/73	-	46	5,100	-	-
12/ 2/58	1.1	-	24,000	-	5,860
1/21/59	0.9	-	9,300	-	15,200
2/ 3/59	0.8	-	930	-	8,520
3/24/59	1.1	-	2,400	-	10,100
6/14/60	0.9	-	-	-	6,510
9/13/60	1.0	-	3,700	-	5,980

SOURCE: State of Tennessee, Water Quality Control Division, and "Water Quality of Tennessee Surface Streams (1960-1964), "Tennessee Stream Pollution Control Board.

Table 2.5-10

Dilution of Contaminants and Transit Time Between Plant Site and Points of Water Intake Down to Old Hickory Dam

Water User	Point of Water Intake	Distance Between Intake and Plant Site at CRM 285.0	Dilution Factor	Transit Time Between Point of Discharge and Point of Use
	CRM	river miles		hours
1. Hartsville	278.6	6.4	0.22×10^{10}	3.9
2. Lebanon	262.9	22.1	1.12×10^{10}	11.9
3. Gallatin Steam Plant	243.6	41.4	3.13×10^{10}	27.6
4. Gallatin	239.2	45.8	4.26×10^{10}	31.9
5. Camp Boxwell	236.0	49.0	5.43×10^{10}	35.1
6. Easter Seal's Crippled Children's Camp	236.0	49.0	5.43×10^{10}	35.1
7. Old Hickory Utility District	219.0	66.0	9.71×10^{10}	57.5
8. Whitehouse Utility District	216.5	68.5	12.8×10^{10}	61.2
9. Old Hickory Dam and Recreation Area	216.2	68.8	12.8×10^{10}	61.6

Table 2.5-11

TRANSPORT TIME FROM THE HARTSVILLE NUCLEAR PLANT

Public Water Supply	Location (Cumberland River Mile)	Average Transport Time In River (Days)	Average Riverflow (cfs)
Hartsville Nuclear Plant	285.0	0.0	17,600
Hartsville	278.6	0.3	17,700
Lebanon	262.9	1.1	18,100
Gallatin Steam Plant	243.6	2.5	18,700
Gallatin	239.2	3.0	18,800
Camp Boxwell	236.0	3.4	18,900
Easter Seals Camp	236.0	3.4	18,900
Old Hickory Utility District	219.0	5.1	19,400
Whitehouse Utility District	216.5	5.3	19,400
Old Hickory Dam Rec. Area	216.2	5.3	19,400
Cumberland Water Co.	207.7	5.5	19,700
Madison Suburban Utility Dist.	200.2	5.6	19,800
Nashville	193.8	5.7	20,000
Harpeth Valley Utility Dist.	172.5	6.5	20,700
River Road Utility District	159.9	7.0	21,100
Cheatham Dam Rec. Area	149.7	7.3	21,600
Clarksville	126.5	8.0	23,200
Dover	89.5	9.9	24,400
Kentucky State Peniten.	43.7	20.0	26,400
Barkeley Dam Rec. Area	30.6	23.0	26,800

Table 2.5-12

RESULTS OF WATER LEVEL MEASUREMENTS IN OBSERVATION
WELLS AT HARTSVILLE - JANUARY 1973 THROUGH NOVEMBER 1973

In Feet Above Mean Sea Level

Well No.	Surface Elevation	1/23/73	2/7/73	3/15/73	4/19/73	5/10/73	6/21/73	7/19/73	8/23/73	9/27/73	10/18/73	11/14/73
1	591.5	573.2	575.6	576.7	576.3	577.0	576.9	576.5	576.5	576.1	575.9	575.9
2	543.9	529.7	529.8	530.7	528.8	529.7	527.9	528.1	528.1	527.5	527.7	528.8
3	591.8	542.9	543.2	543.5	542.8	543.2	542.5	542.4	542.3	541.6	541.5	540.9
4	476.8	471.4	472.7	475.6	471.7	474.6	469.4	468.1	468.1	461.5	459.2	459.2
5	482.0	460.5	462.0	470.3	459.0	464.1	455.7	454.7	452.8	448.6	447.8	447.6
6	508.1	458.8	459.9	465.5	457.4	488.1	457.1	457.5	456.5	455.2	455.1	455.2
7	470.4	446.8	447.5	447.7	447.4	447.8	447.4	448.6	446.6	444.8	444.6	455.5
8	470.0	447.0	447.7	448.4	447.7	448.1	447.6	448.8	446.7	444.8	444.6	445.5
9	469.2	453.1	453.2	457.1	453.8	453.6	451.6	451.4	449.9	446.9	446.3	446.3

Table 2.5-13

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Map No.	Location		Well Depth feet	Estimated Elevation feet		Well Diameter feet	Remarks
	Latitude	Longitude		Ground	Water Surface		(Pump Size, etc.)
1	36°21'14"	86°05'10"	140	520	479	.5	Unknown
2	36°21'19"	86°05'41"	70	515	465	.5	1-hp
2a	36°21'15"	86°05'44"	96	480	-	.5	1/2-hp
3	36°22'06"	86°06'13"	22	550	530	3.5	Unknown
4	36°21'48"	86°05'59"	39	533	526	.5	No pump; not used
5	36°21'26"	86°05'43"	62	510	478	.5	No pump
6	36°21'10"	86°05'59"	-	490	-	.5	No pump; well plugged
7	36°21'02"	86°06'07"	90	565	Dry	.5	No pump; not used
8	36°21'12"	86°06'49"	124	510	471	.5	1.5-hp
9	36°21'03"	86°06'38"	21	460	459	.5	No pump
10	36°21'17"	86°06'28"	125	510	450	.5	Unknown
11	36°21'10"	86°06'54"	66	490	439	.5	3/4-hp
12	36°21'12"	86°06'57"	70	495	430	.5	3/4-hp

Table 2.5-13 (continued)

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Map No.	Location		Well Depth feet	Estimated Elevation (feet)		Well Diameter feet	Remarks (Pump Size, etc.)
	Latitude	Longitude		Ground	Water Surface		
13	36°21'16"	86°07'04"	18	490	475	.5	No pump; not used
14	36°21'16"	86°07'05"	72	490	470	.5	No pump
15	36°21'27"	86°04'32"	207	520	470	.5	Unknown
16	36°21'29"	86°04'29"	75	500	465	.5	Unknown
17	36°21'22"	86°04'25"	230	500	485	.5	Unknown; not used
18	36°20'48"	86°04'48"	62	475	423	.8	3/4-hp
19	36°21'05"	86°04'32"	120	480	-	.5	Unknown; not used
20	36°21'06"	86°04'33"	80	480	-	.5	Unknown; not used
21	36°21'36"	86°04'47"	200	550	470	.5	2-hp; not used
22	36°22'04"	86°05'30"	120	670	580	.5	No pump
23	36°21'56"	86°04'38"	30	530	524	.5	1/2-hp; not used
24	36°22'04"	86°04'39"	74	580	520	.5	No pump

Table 2.5-13 (continued)

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Map No.	Location		Well Depth	Estimated Elevation		Well Diameter	Remarks
	Latitude	Longitude	feet	Ground	Water Surface	feet	(Pump Size, etc.)
				feet			
25	36°22'04"	86°04'38"	84	580	520	.5	3/4-hp
26	26°22'10"	86°04'35"	30	510	490	.5	No pump
27	36°22'12"	86°06'18"	50	585	547	.5	No pump; not used
28	36°22'10"	86°05'58"	113	560	525	.66	3/4-hp
29	36°22'09"	86°05'59"	50	550	530	.5	1-hp
30	36°22'02"	86°05'15"	200	620	616	.5	Hand pump; not used
31	36°22'12"	86°05'10"	65	620	560	.5	1/4-hp
32	36°22'01"	86°05'07"	-	585	-	.5	3/4-hp
33	36°22'11"	86°05'38"	150	695	693	.5	3/4-hp
34	36°22'13"	86°05'48"	65	680	627	.5	No pump; not used
35	36°22'14"	86°05'51"	90	640	570	.5	3/4-hp
36	36°22'16"	86°05'55"	51	600	567	.5	No pump

Table 2.5-13 (continued)

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Map No.	Location		Well Depth feet	Estimated Elevation feet		Well Diameter feet	Remarks (Pump Size, etc.)
	Latitude	Longitude		Ground	Water Surface		
37	36°22'20"	86°05'56"	128	580	566	.5	No pump
28	36°22'14"	86°06'04"	130	600	533	.5	1-hp
39	36°22'18"	86°06'15"	85	635	580	.5	1/2-hp
40	36°22'21"	86°06'41"	50	610	585	.5	No pump
41	36°22'20"	86°06'42"	80	610	Dry	.5	No pump
42	36°21'15"	86°06'56"	140	510	440	.5	3/4-hp
43	36°22'09"	86°06'03"	200	560	539	.5	No pump
44	36°22'21"	86°06'10"	99	640	600	.5	3/4-hp
45	36°22'02"	86°05'02"	-	580	-	.5	1/4-hp
46	36°22'04"	86°04'49"	55	555	529	.5	1/3-hp
47	36°22'01"	86°04'50"	36	540	538	.5	No pump
48	36°21'59"	86°04'23"	160	485	335	.5	1/4-hp
49	36°22'45"	86°04'34"	-	540	-	.5	Well plugged

Table 2.5-13 (continued)

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Map No.	Location		Well Depth	Estimated Elevation		Well Diameter	Remarks
	Latitude	Longitude	feet	Ground	Water Surface	feet	(Pump Size, etc.)
				feet			
50	36°22'46"	86°03'57"	60	530	500	.5	3/4-hp
51	36°22'38"	86°03'49"	43	520	492	.5	No pump; not used
52	36°22'41"	86°03'58"	42	540	504	.5	No pump
53	36°22'33"	86°03'58"	19	498	489	.5	Hand pump; not used
54	36°22'22"	86°03'59"	-	522	-	.5	Not used
55	36°22'17"	86°04'05"	98	516	468	.5	3/4-hp
56	36°21'45"	86°04'07"	90	480	399	.5	3/4-hp
57	36°21'42"	86°03'44"	20	465	460	4.0	1-hp
58	36°21'44"	86°03'34"	22	485	478	-	No pump
59	36°21'44"	86°03'32"	130	485	460	.5	1-hp
60	36°22'13"	86°04'12"	150	540	460	.5	Unknown
61	36°21'38"	86°03'05"	100	470	450	.3	1/2-hp
62	36°21'36"	86°03'06"	90	470	450	.5	1/2-hp

Table 2.5-13 (Continued)

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Map No.	Location		Well Depth	Estimated Elevation		Well Diameter	Remarks
	Latitude	Longitude		Ground	Water Surface		(Pump Size, etc.)
			feet	feet		feet	
63	36°21'36"	86°03'08"	100	470	450	.3	1/2-hp; not used
64	36°21'37"	86°02'59"	85	480	450	.3	3/4-hp
65	36°21'35"	86°03'04"	58	480	-	.5	1/2-hp
66	36°21'35"	86°03'05"	62	480	-	.5	1/2-hp
67	36°21'35"	86°03'0[illegible]"	30	470	-	.3	1/3-hp
68	36°21'34"	86°03'09"	55	470	-	.5	1/2-hp
69	36°21'34"	86°03'12"	35	470	-	.5	1/2-hp
70	36°21'32"	86°03'12"	39	470	460	.5	1/2-hp
71	36°21'31"	86°03'11"	50	470	420	.5	1/2-hp
72	36°21'31"	86°03'10"	30	475	-	.5	1-hp
73	36°21'31"	86°03'05"	-	480	-	.5	3/4-hp
74	36°21'31"	86°03'04"	-	484	-	.5	1/2-hp
75	36°21'30"	86°03'04"	35	490	-	.5	1/2-hp

Table 2.5-13 (Continued)

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Map No.	Location		Well Depth feet	Estimated Elevation feet		Well Diameter feet	Remarks (Pump Size, etc.)
	Latitude	Longitude		Ground	Water Surface		
76	36°21'30"	86°03'03"	68	500	471	.5	1/3-hp
77	36°21'30"	86°03'02"	21	505	493	3.0	No pump; not used
78	36°21'29"	86°03'00"	160	510	-	.5	1/2-hp
79	36°21'28"	86°03'02"	42	515	-	.5	1/2-hp
80	36°21'29"	86°03'04"	-	500	-	.5	1/2-hp
81	36°21'29"	86°03'05"	70	495	452	.5	1/2-hp
82	36°21'30"	86°03'06"	51	480	-	.5	3/4-hp
83	36°21'29"	86°03'11"	50	480	-	.3	1/2-hp
84	36°21'28"	86°03'11"	62	480	450	.5	3/4-hp
85	36°21'24"	86°03'15"	32	475	-	.5	3/4-hp
86	36°21'18"	86°03'13"	163	530	440	.5	3/4-hp
87	36°21'16"	86°03'25"	70	470	454	.5	No pump;not used
88	36°21'11"	86°03'17"	100	490	-	.5	1/2-hp

Table 2.5-13 (Continued)

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Map No.	Location		Well Depth	Estimated Elevation		Well Diameter	Remarks
	Latitude	Longitude	feet	Ground	Water Surface	feet	(Pump Size, etc.)
				feet			
89	36°21'11"	86°03'24"	60	480	-	.5	1/2-hp; not used
90	36°20'56"	86°03'26"	60	535	478	.3	No pump; not used
91	36°20'52"	86°03'27"	-	540	-	.5	Well plugged
92	36°20'48"	86°03'27"	60	545	-	.5	1-hp
93	36°20'29"	86°03'21"	150	560	480	.5	1-hp
94	36°20'42"	86°02'58"	200	560	-	.5	1-hp
95	36°20'35"	86°03'37"	99	540	476	.5	1/2-hp
96	36°20'18"	86°03'33"	80	530	-	.5	3/4-hp
97	36°20'12"	86°03'34"	88	530	-	.5	3/4-hp
98	36°19'59"	86°03'42"	-	495	-	.5	1-hp
99	36°19'51"	86°03'55"	63	465	-	.5	1/2-hp
100	36°19'38"	86°04'51"	100	510	476	.5	3/4-hp
101	36°19'52"	86°04'24"	80	500	471	.5	No pump

Table 2.5-13 (Continued)

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Map No.	Location		Well Depth	Estimated Elevation		Well Diameter	Remarks
	Latitude	Longitude	feet	Ground	Water Surface	feet	(Pump Size, etc.)
				feet			
102	36°20'01"	86°04'31"	-	500	-	.5	1/2-hp
103	36°20'02"	86°04'31"	70	500	476	.5	No pump; not used
104	36°20'06"	86°04'26"	38	490	482	.5	1/2-hp
105	36°20'21"	86°05'04"	220	475	-	.5	1/2-hp
106	36°20'21"	86°05'05"	50	475	-	.3	1/2-hp
107	36°19'41"	86°05'41"	100	550	532	.3	No pump
108	36°19'53"	86°05'36"	79	485	464	.5	1/2-hp
109	36°20'05"	86°05'35"	75	485	440	.5	1/3-hp
110	36°20'13"	86°05'49"	200	520	455	.5	Unknown
111	36°20'26"	86°05'53"	87	490	447	.3	3/4-hp
112	36°20'26"	86°06'09"	100	520	459	.5	3/4-hp
113	36°20'31"	86°06'33"	100	510	458	.5	No pump; not used
114	36°20'36"	86°06'28"	70	470	-	.5	1/2-hp

Table 2.5-13 (continued)

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Springs

Map No.	Location Latitude	Longitude	Estimated Elevation Ground feet	Flow gpm	Remarks (Pump Size, etc.)
115	36°21'15"	86°05'08"	510	2	No pump; stock
116	36°21'01"	36°05'10"	475	10	No pump; not used
117	36°21'21"	86°05'55"	480	20	Unknown; domestic
118	36°21'05"	86°06'01"	500	50	3/4-hp; domestic
119	36°21'10"	86°07'17"	480	84	Unknown; domestic
120	36°21'26"	86°04'21"	460	20	No pump; not used
121	36°21'44"	86°04'47"	560	90	Unknown; domestic
122	36°21'39"	86°04'48"	540	582	Unknown; domestic, stock
123	36°22'01"	86°05'23"	680	17	Unknown; domestic
124	36°21'58"	36°05'26"	740	33	No pump; not used
125	36°21'06"	86°04'36"	475	2	No pump; not used

Table 2.5-13 (Continued)

WELL AND SPRING INVENTORY

WITHIN 2-MILE RADIUS OF HARTSVILLE NUCLEAR PLANT SITE

Springs

Map No.	Location		Estimated Elevation Ground feet	Flow gpm	Remarks (Pump Size, etc.)
	Latitude	Longitude			
126	36°21'12"	86°04'46"	485	218	No pump; stock
127	36°22'04"	86°04'31"	540	45	No pump; not used
128	36°22'10"	86°06'24"	540	175	No pump; stock
129	36°22'06"	86°05'56"	580	30	No pump; stock
130	36°21'28"	86°05'41"	500	87	No pump; not used
131	36°22'55"	86°04'39"	540	20	No pump; not used
132	36°22'13"	86°05'37"	700	10	No pump; stock
133	36°21'21"	86°03'09"	500	58	No pump; stock
134	36°21'13"	86°03'08"	485	15	No pump; stock
135	36°21'12"	86°03'09"	485	5	No pump; none
136	36°20'12"	86°03'10"	480	-	1-hp; domestic

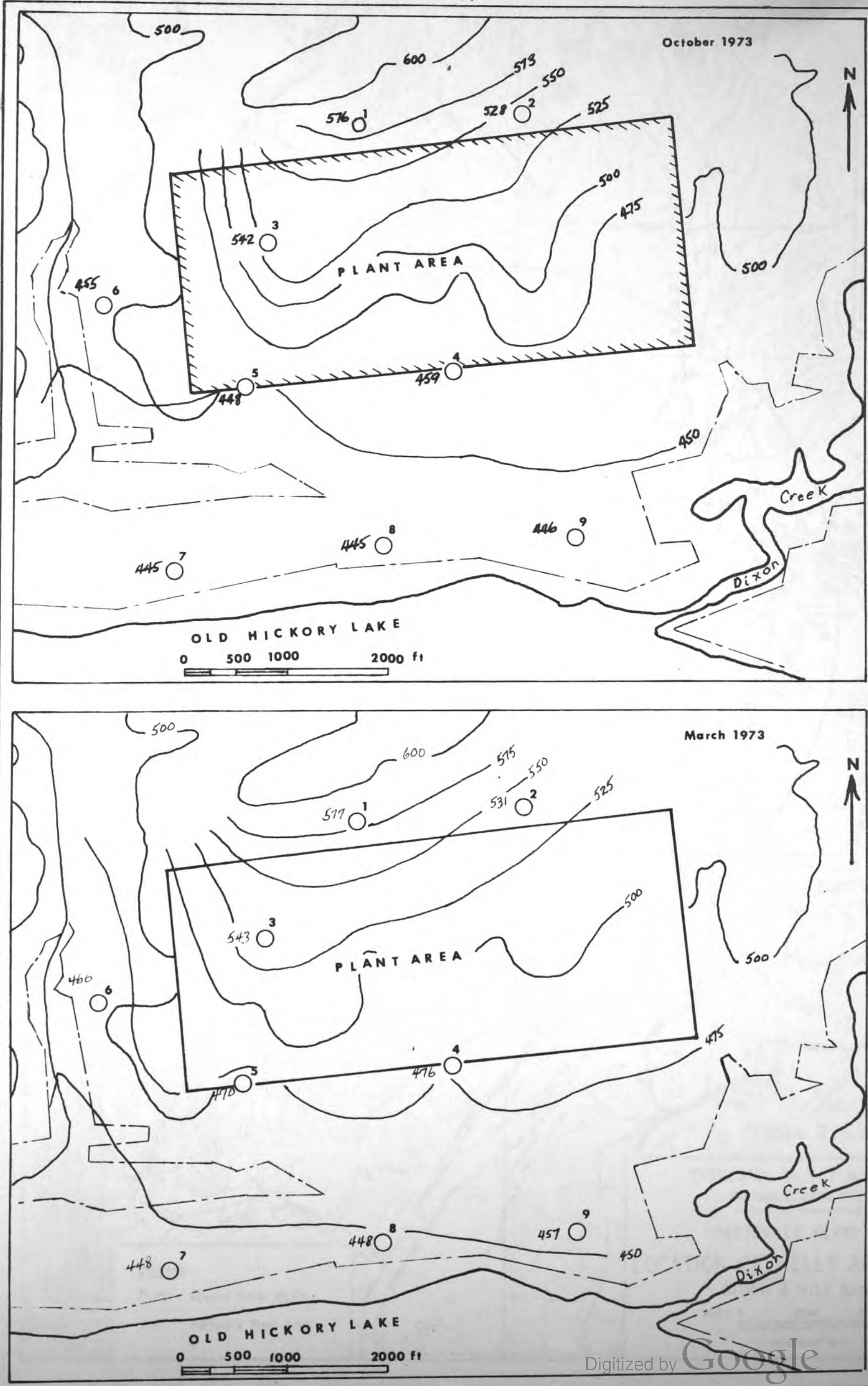


Figure 2.5-1

GENERALIZED WATER-TABLE MAPS FOR THE HARTSVILLE SITE DURING PERIOD OF LOW WATER LEVEL (OCTOBER 1973) AND PERIOD OF HIGH WATER LEVEL (MARCH 1973)

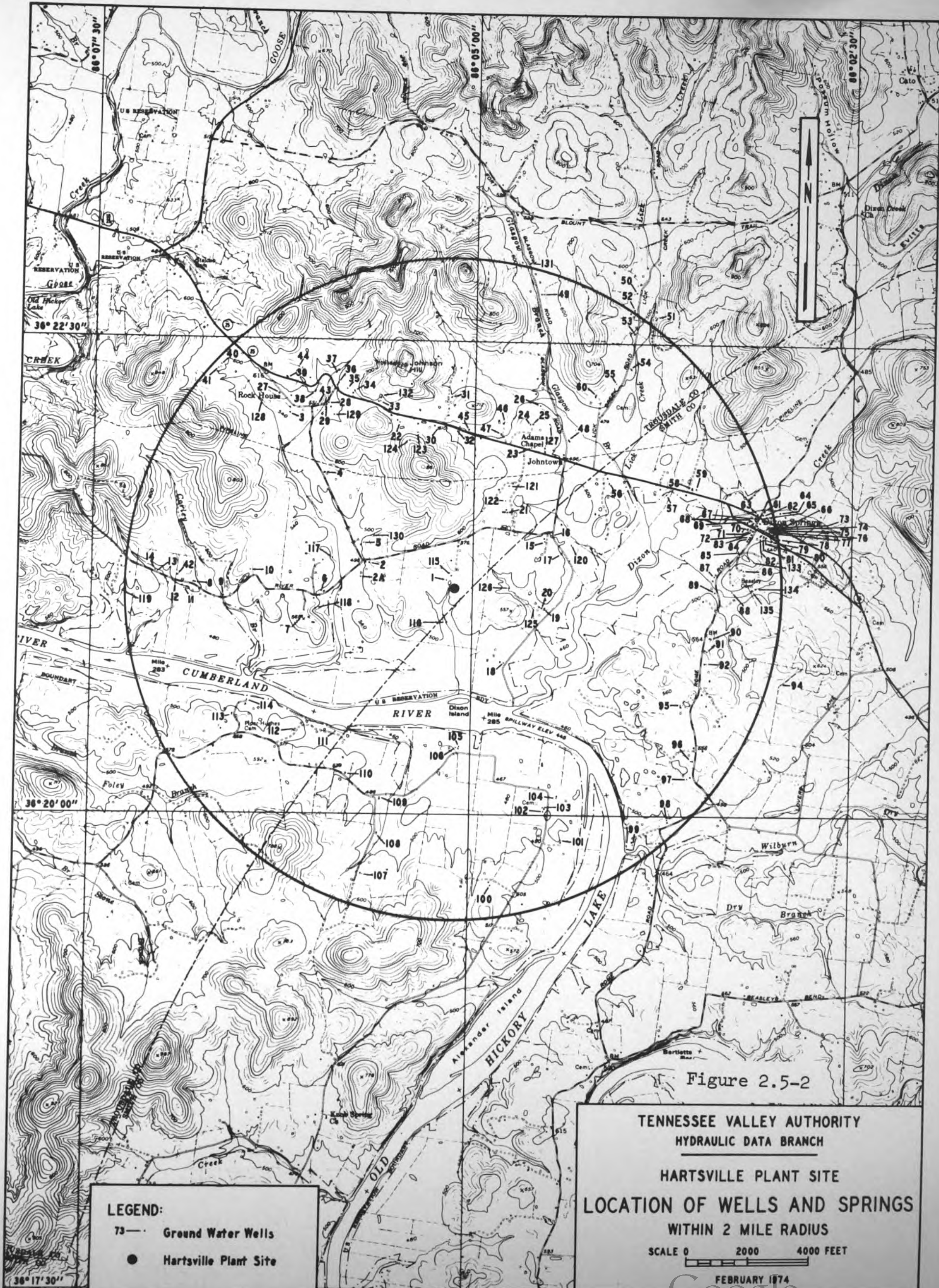


Figure 2.5-2

TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH

HARTSVILLE PLANT SITE
LOCATION OF WELLS AND SPRINGS
WITHIN 2 MILE RADIUS

SCALE 0 2000 4000 FEET

FEBRUARY 1974

2.6 Meteorology

2.6.1 Regional Climate - The Hartsville Nuclear Plant site is located in a temperature latitude in northcentral Tennessee about 450 miles north of the Gulf of Mexico and in a region which is dominated much of the year by the Azores-Bermuda anticyclonic circulation.[1] This circulation is most pronounced in the fall and is accompanied by extended periods of fair weather, widespread atmospheric stagnation and smog.[2] In the winter, the normal circulation becomes diffuse over the southeastern part of the country as the eastward-moving migratory high- or low-pressure systems, identified with the midlatitude westerly upper circulation, bring alternately cold and warm air masses into the Hartsville site area with resultant changes in wind, atmospheric stability, precipitation, and other meteorological elements. In summer, the migratory systems are less frequent and less intense since the site area is under the influence of the western extension of the Azores-Bermuda anticyclonic circulation with frequent incursions of warm moist air from the Atlantic Ocean and the Gulf of Mexico.

2.6.2 Severe Weather - Severe windstorms may occur several times a year,[3] particularly during the winter, spring, and summer with winds reaching 35 mi/h and occasionally exceeding 60 mi/h. The highest wind speed recorded[3] at the Nashville National Weather Service Station, 37 miles southwest of the plant site, was 73 mi/h and the highest peak wind speed recorded at the the plant site during the first year, February 1973-January 1974,

of operation of the onsite temporary meteorological facility was 50 mi/h. High wind may also accompany moderate-to-strong cold frontal passages 30 to 40 times a year with the maximum frequency in March and April. High wind may accompany thunderstorms, which occur about 55 times a year with the maximum in July.[3] On rare occasions, thunderstorms may cause extensive damage to property from heavy rain (flash floods), lightning, and hail.[4]

With regard to the probability of tornado occurrence at the Hartsville site, records show that in a 58-year period, 1916-1973 there were nine tornadoes reported in Smith and Trousdale Counties where the site is located.[5,6,7] A tornado touched down in the southeastern section of Trousdale County, Tennessee, on April 3, 1974. The tornado's path of destruction was approximately 1,500 feet wide and several miles long. The path crossed the proposed plant reservation along the western boundary as shown in figure 2.6-1. Tornadoes in the area usually move in a northeasterly direction and, according to H.C.S. Thom,[8] cover an agerage surface area of 2.8 square miles. Winds of 150 to 200 mi/h are common in the whirl and are estimated to occasionally reach 300 mi/h. Using the principal of geometric probability described by Thom,[4,8] the probability of a tornado at the Hartsville site is .0015, or a recurrence interval of about 840 years.

Days of high air pollution potential have been depicted by George C. Holzworth[9] who represents an expected frequency of high meteorological potential for air pollution. Over a 5-year period, his data show there would be about 30 days, or about 6 days annually, that such conditions would likely affect the site area.

The highest monthly average rainfall usually occurs during the winter through early spring and in the summer. The maximum 24-hour precipitation, representative of the plant site area, was 8.35 inches on August 3, 1893, at Carthage, Tennessee, 10 miles southeast of the Hartsville site. Precipitation data from both Carthage and the Gallatin Steam Plant station, 18 miles west-southwest of the plant site, since the mid-1950's indicate maximum 24-hour precipitation varying between 4.3 and 4.7 inches. Minimum precipitation normally occurs in October when the regional anti-cyclonic circulation is most dominant.

The occurrence of snow or freezing rain, including the storms in the midwinter period, is not uncommon. Severe snow or ice storms causing appreciable damage to property and inconvenience to travel may occur on the average of once every 3 years.[10]

Hail storms of significant intensity would rarely occur in the Hartsville site area. The probable recurrence interval of hail (3/4 inch or greater) is about 1,136 years.[4,8]

2.6.3 Local Meteorology - Because of the shallow valley and surrounding irregular terrain, marked throughout by low rolling hills, there is an absence of pronounced river-valley or valley-ridge features in the proximity of the plant site area. Some minor discontinuities can be expected in the prevailing low-level regional wind because of the higher terrain to the north-northeast through east which slopes downward into the shallow and elongated east-west valley where the plant site is located. The principal effect of this topographic configuration on the dispersion of gaseous effluent

releases from the Hartsville plants would be one of limited confinement within the shallow valley by the weak and stable east and east-northeast downvalley drainage winds. Ground-level concentrations therefore would likely be the greatest in the west and west-southwest downvalley sections. No local wind effects are expected from differential surface heating between land and water because of the narrow Cumberland River as it flows westward along the south boundary of the plant site.

2.6.3.1 Temperature - The predominant air masses affecting the Hartsville site area may be described interchangeably continental and maritime in winter and spring, predominantly maritime in summer, and continental in fall. A summary of 89 years of temperature data (table 2.6-1) collected at the Carthage, Tennessee, Cooperative Observer's Station shows a mean annual temperature of 59.3°F. with the mean monthly temperature ranging from 39.4°F. in January to 78.3°F. in July. The highest temperature on record is 111°F. in August and the lowest, -18°F. in February, resulting in an extreme annual range of 129°F. There are normally 40 days in the year when maximum temperature are 90°F. and above and 81 days when the minimum temperatures are 32°F. and below.[3]

2.6.3.2 Relative Humidity - Representative annual and monthly relative humidity values, based on a 7-year period (1966-1972) of data (table 2.6-2) collected at the Nashville National Weather Service Station, show that the average annual relative humidity is 70.3 percent with the average monthly range from 61.3 percent in March to 76.5 percent in August. The 6-hour diurnal distribution

of the monthly average value shows that the highest relative humidities occur at 0600 hours central standard time in July, August, and September with respective values of 90, 92, and 90 percent. The lowest monthly average is the March 1200 hours local time value of 50 percent.

2.6.3.3 Precipitation - Precipitation patterns, based on a 21-year period (1953-1973) of data (table 2.6-3) collected at the TVA raingage station at the Gallatin Steam Plant, 18 miles west-southwest of the Hartsville site, show that annually there are 110 days with 0.01 inch or more of precipitation. Precipitation patterns, based on a 22-year period (1951-1972) of data (table 2.6-4), collected at the Carthage, Tennessee, Cooperative Observer's Station, show that the average annual precipitation is 52.49 inches, with the average monthly maximum, 5.79 inches, occurring in December and the average monthly minimum, 2.72 inches, occurring in October. The extreme monthly maximum and minimum are 13.00 inches in March and 0.51 inch in October, and the maximum 24-hour precipitation is 8.35 inches in August.

Appreciable snowfall seldom occurs at the Hartsville site as indicated by the representative Carthage snowfall data (table 2.6-5). The average annual snowfall for the approximate 74-year period, 1887-1960, is only 7.4 inches and occurs mostly during December through March.

2.6.3.4 Fog - No observations of the frequency and intensity of fogs have been made in the Hartsville site area. However, Nashville National Weather Service Station records for 31 years (1942-1972)

indicate that heavy fogs (visibility equal to or less than 1/4 mile) occur about 17 days annually (table 2.6-6) with a maximum monthly frequency of 3 days in January and a minimum of 1 day from February through July and September.

2.6.3.5 Atmospheric Stability - The joint percentage frequencies of wind direction and wind speed for the Pasquill stability classes, A through G, are given in Appendix C (Tables C-2 through C-8 and figures C-1 through C-7). The most stable classes, E, F, and G, occur 28.64, 12.41, and 10.85 percent, respectively; the least stable class, A, occurs 11.43 percent. The two most critical conditions, F, 0.6-3.4 mi/h, and G, 0.6-3.4 mi/h (tables C-7 and C-8, figures C-6 and C-7), occur 8.88 and 8.02 percent, respectively. The highest occurrences of G, 0.6-3.4 mi/h (table C-8, figure C-7), with respect to wind direction, are 4.29 and 1.49 percent with east-northeast and northeast winds. These conditions are likely identified with the weak night downvalley or drainage wind regime shown in table C-36 and figure C-37. The G, 3.5-7.4 mi/h, condition also shows a significant occurrence of 2.15 percent with east-northeast wind.

The data in figures C-8 and C-9 show the percent occurrence of Pasquill stability classes A through G by time (hours) of day. About 87 percent of the stability class G condition (figure C-9) occurs between 2100 and 0700 LT with the highest occurrence at 2200 LT. The slightly less stable condition, F, shows the same general pattern although the highest frequencies appear to persist from 2400 until 0400 LT.

The initial occurrence (about 2100 LT) of the class G stability condition may reflect the onset of the shallow downvalley drainage wind.

The data in figure C-8 show the expected maximum daytime occurrence of the least stable classes, A, B, and C. Also, the data reflect the expected distribution of the stability class D as identified with the midmorning (0900 LT) and late afternoon (1600-1800 LT) transitional periods.

2.6.3.6 Wind Direction - Data from the 33- (10-meter) and 150-foot wind instruments at the onsite temporary meteorological facility for the 1-year period, February 1973-January 1974, are used to identify the expected annual low-level wind pattern in the site area. The annual and monthly wind data from the 33-foot tower level (tables C-9 through C-21, figures C-10 through C-22) show predominant east-northeast and northeast winds. In the annual pattern (table C-9, figure C-10), the prevailing wind direction, east-northeast, occurs 17.13 percent with the next highest percentage, 11.05 percent, for northeast winds. The two highest percentages of monthly wind directions are 28.47 percent in September and 25.94 percent in October, both for east-northeast wind. These values are identified, in part, with the weak anticyclonic flow which normally occurs over the area during the fall season. The remaining months also show, to lesser degrees, the prevalent northeasterly component winds. There is evidence that the terrain features common to the site and peripheral areas could favor a dominant low-level east-northeasterly wind within the relatively shallow and irregularly

defined, east-west aligned valley. The highest ridge-type terrain, 300 to 500 feet above plant grade, lies about 2 miles to the north and northeast. However, in most sectors irregular rolling hills, 200 to 300 feet high, surround the site area out to distances beyond 10 to 15 miles.

To further identify the local wind pattern, the 1 year of data (February 1973-January 1974) from the 33-foot tower level was evaluated for day, 0800-2000 hours LT, and night, 2000-0800 hours LT, periods. The data (tables C-35 and C-36, figures C-36 and C-37) show that the night wind pattern has dominating east-northeast and northeast winds 39.57 percent of the time, while during the day the same wind directions occur only 16.74 percent. Thus, the data indicate the presence of a local nighttime downvalley or drainage-type wind. The 150-foot wind patterns for the day and night periods (tables C-37 and C-38, figures C-38 and C-39) are more uniform with the prevailing southeasterly directions and perhaps begin to reflect the higher level regional winds.

2.6.3.7 Wind Speed - The annual and monthly patterns of wind speed at the 33-foot (10-meter) tower level at the onsite temporary meteorological facility are shown in tables C-9 through C-21 and figures C-10 through C-22. Similar wind speed patterns at the 150-foot tower level are shown in tables C-22 through C-34 and figures C-23 through C-35. The data show that calms at the 33-foot tower level over the 1-year period, February 1973-January 1974, occurred 1.88 percent; 0.6-3.4 mi/h wind, 37.71 percent; and 3.5-7.4 mi/h wind, 35.36 percent. The highest annual frequencies

of 0.6-3.4 mi/h wind with respect to direction are 10.78 and 6.57 percent with east-northeast and northeast winds, respectively. The dominance of the east-northeast, 0.6-3.4 mi/h wind, may be attributed to the east-west alignment of the shallow valley where the plant site is located. This terrain influence on the wind is particularly apparent for the night (2000-0800 LT) period (table C-36, figure C-37) when about 57 percent of the 0.6-3.4 mi/h winds were from the east-northeast and northeast. The frequency of calm for this night period was 2.17 percent.

The lowest wind speeds, calm and 0.6-3.4 mi/h, have their highest frequency during the summer through early fall (June through October) periods when the regional anticyclonic circulation is most uncommon. Correspondingly, they occur less frequently during late fall through spring (November through May) during the period of optimum migration of cyclonic disturbances through the area.

These same data (table C-9, figure C-10) show that moderate to high wind speeds (equal to or greater than 7.5 mi/h) occur 25.06 percent of the time. February through April have the highest frequencies while June through October have the lowest. The highest annual occurrences, with respect to direction, are 2.68 and 2.41 percent with southwest and west winds respectively.

Some further evaluation of the expected wind speed conditions can be drawn from the day (0800-2000 LT) and night (2000-0800 LT) wind speed data from the 33-foot tower level at the onsite temporary meteorological facility (tables C-35 and C-36, figures C-36 and C-37. The data show that the lowest wind speeds, calm and 0.6-3.4 mi/h, occur 49.29 percent during the night period and

29.85 percent during the day period. Furthermore, the moderate to high wind speed (equal to or greater than 7.5 mi/h) occurs 32.94 percent of the time during the day period and 17.25 percent during the night period.

References for Section 2.6

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2. U.S. Atomic Energy Commission, ORO-99, A Meteorological Survey of the Oak Ridge Area, page 192, Weather Bureau, Oak Ridge, Tennessee, November 1953.

3. Local Climatological Data - Annual Summary With Comparative Data, 1972, Nashville, Tennessee, U.S. Department of Commerce, 1973.

4. Severe Local Storm Occurrences, 1955-1967, ESSA Technical Memorandum WBTM FCST 12, U.S. Department of Commerce, September 1969.

5. Tornadoes in Tennessee (1916-1970) With Reference to Notable Tornado Disasters in the United States (1880-1970), John V. Vaiksnoras, Issued by the University of Tennessee Institute for Public Service, Knoxville, Tennessee, Revised October 1972.

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8. Tornado Probabilities, H.C.S. Thom, Monthly Weather Review, October-December 1963, pages 730-736.

9. Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States, George C. Holzworth, Environmental Protection Agency, Division of Meteorology, January 1972.

10. Glaze - Its Meteorology and Climatology, Geographical Distribution, and Economic Effects, Technical Report EP-105, U.S. Army, Engineering Command, Quartermaster Research and Engineering Center, Environmental Protection Research Division, Natick, Massachusetts, March 1959.

Table 2.6-1

TEMPERATURE DATA

CARTHAGE, TENNESSEE

Month	Mean Monthly[1] [°F.] (a,b)	Mean Daily Maximum[4] [°F.] (a)	Mean Daily Minimum[5] [°F.] (a)	Highest Temp.[3] [°F.] (a)	Lowest Temp.[2] [°F.] (a)
December	41.3	51.5	31.6	76	-4
January	39.4	50.9	30.8	82	-17
February	41.6	53.0	31.6	83	-18
Winter	40.8	51.8	31.3		
March	49.6	62.4	39.0	92	-4
April	59.4	72.1	47.1	95	20
May	67.6	80.7	55.6	98	33
Spring	58.9	71.7	47.2		
June	75.4	88.2	63.8	105	41
July	78.3	91.0	67.1	110	49
August	77.4	90.5	66.2	111	46
Summer	77.0	89.9	65.7		
September	72.3	86.0	59.4	108	32
October	60.1	75.2	48.3	96	23
November	49.0	61.4	37.8	85	0
Fall	60.5	74.2	48.5		
Annual	59.3	71.9	48.2	111	-18

a. "Decennial Census of U.S. Climate, Climatic Summary of the United States, Supplement for 1951 through 1960, Tennessee," 1965, U.S. Department of Commerce.

b. "Climatological Data, Tennessee, Annual Summary," 1961-1972, U.S. Department of Commerce.

Table 2.6-1

Continued

1. Period of record, 1884-1972 (Average temperature for June, August, September, October, November, and December 1963 and January, February, March, and April 1963 missing from record.)

2. Period of record, 1885-1960.

3. Period of reocrd, 1884-1960.

4. Period or record, 1989-1960.

5. Period of record, 1900-1960.

Table 2.6-2

RELATIVE HUMIDITY DATA*

NASHVILLE, TENNESSEE

Month	Avg. R.H. 0000 LT	Avg. R.H. 0600 LT	Avg. R.H. 1200 LT	Avg. R.H. 1800 LT	Monthly Average
January	74	80	64	65	70.8
February	72	78	59	60	67.3
March	68	75	50	52	61.3
April	72	79	52	54	64.3
May	82	86	55	57	70.0
June	84	87	53	58	70.5
July	86	90	58	63	74.3
August	87	92	61	66	76.5
September	85	90	58	65	74.5
October	81	87	55	62	71.3
November	77	81	59	64	70.3
December	76	80	65	68	72.3
Annual	78.7	83.7	52.4	61.2	70.3

*"Local Climatological Data, Annual Summary with Comparative Data," 1972, Nashville, Tennessee, U.S. Department of Commerce, Period of record, 1966-1972.

Table 2.6-3

PRECIPITATION DATA
GALLATIN STEAM PLANT

May 1953-December 1973

Month	Monthly Average (inches)	Extreme Monthly Maximum (inches)	Extreme Monthly Minimum (inches)	Max. In. 24 Hours (inches)	Average No. of Days with 0.01 inch or More
December	4.61	7.90	1.01	3.10	10
January	4.19	9.54	1.17	4.27	10
February	4.65	10.09	0.55	4.06	10
Winter	13.45				30
March	5.14	10.65	1.72	2.87	12
April	4.54	7.32	1.31	2.67	11
May	4.35	7.47	1.31	2.75	10
Spring	14.03				33
June	3.64	7.48	0.69	3.71	8
July	4.54	9.77	1.62	4.30	10
August	3.37	8.76	0.22	3.53	7
Summer	11.55				25
September	3.10	6.25	0.61	3.26	7
October	2.47	4.04	0.00	2.29	6
November	3.78	6.80	0.81	3.27	9
Fall	9.35				22
Annual	48.48				110

Table 2.6-4

PRECIPITATION DATA
Carthage, Tennessee

Month	Monthly[1,2] Average (inches)	Extreme[1,2] Monthly Maximum (inches)	Extreme[1,2] Monthly Minimum (inches)	Maximum in 24 Hours (inches) 1883-1949[3]	Maximum in 24 Hours (inches) 1955-1970[4]
December	5.79	11.51	1.12	4.06	3.15
January	4.78	10.58	1.28	4.05	2.79
February	4.99	11.11	.85	3.90	3.44
Winter	15.56				
March	5.37	13.00	1.78	4.50	4.57
April	4.51	6.71	1.20	3.30	2.24
May	3.92	6.09	1.46	2.41	2.30
Spring	13.80				
June	4.29	11.23	1.55	4.72	4.70
July	5.22	10.18	1.37	4.55[5]	2.48
August	3.38	7.57	1.08	8.35[5]	3.99
Summer	12.89				
September	3.98	7.22	1.34	3.67	3.42
October	2.72	5.33	.51	2.40	1.98
November	3.54	7.02	.77	4.50	2.10
Fall	10.24				
Annual	52.49				

Table 2.6-4
(continued)

1. "Decennial Census of U.S. Climate, Climatic Summary of the United States, Supplement for 1951 through 1960, Tennessee," 1965, U.S. Department of Commerce.

2. "Climatological Data, Tennessee, Annual Summary," 1961-1972," U.S. Department of Commerce (August 1963-April 1964 missing from record).

3. "Maximum 24-hour Precipitation in the United States," 1952, U.S. Department of Commerce, Weather Bureau Technical Paper No. 16.

4. "Greatest Daily Precipitation Amount and Date of Occurrence," Carthage, 1955-1970, Mimeograph (August 1963-April 1964 missing from record), U.S. Department of Commerce, NOAA, EDS, Asheville, N. C.

5. August 3, 1893.

Table 2.6-5

SNOWFALL DATA*
Carthage, Tennessee

Month	Monthly Average (inches)
January	2.4[1]
February	2.2[2]
March	1.2[2]
April	.1[3]
May	Trace[3]
June	.0[3]
July	.0[3]
August	.0[3]
September	.0[3]
October	Trace[3]
November	.2[3]
December	1.3[4]
Annual	7.4

*"Decennial Census of U.S. Climate, Climatic Summary of the U.S. Supplement for 1951 through 1960, Tennessee," 1965, U.S. Department of Commerce.

1. Period of record, 1890-1960.
2. Period of record, 1889-1960.
3. Period of record, 1887-1960.
4. Period of record, 1888-1960.

Table 2.6-6

HEAVY FOG DATA*
Nashville, Tennessee
(1942-1972)

Month	Mean No. of Days with Heavy Fog**
December	2
January	3
February	1
Winter	6
March	1
April	1
May	1
Spring	3
June	1
July	1
August	2
Summer	4
September	1
October	2
November	2
Fall	5
Annual	17

*"Local Climatological Data, Annual Summary with Comparative Date," 1972, Nashville, Tennessee, U.S. Department of Commerce.

**Heavy fog is defined as fog reducing the visibility to 1/4 mile or less.

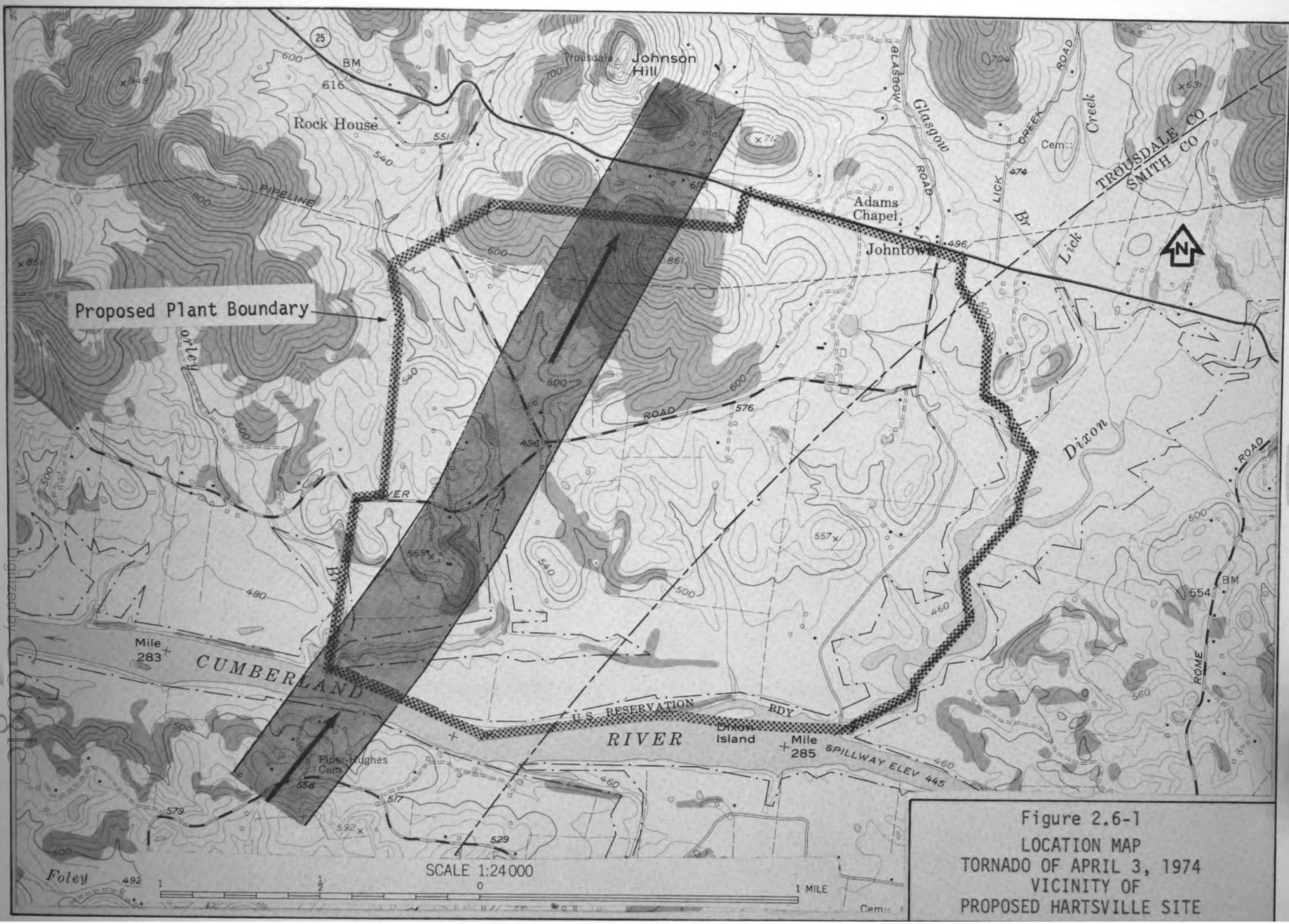


Figure 2.6-1
LOCATION MAP
TORNADO OF APRIL 3, 1974
VICINITY OF
PROPOSED HARTSVILLE SITE

2.7 Ecology

In the process of site selection as described in Section 9, environmental implications of locating a generating plant at each of the various sites under consideration were evaluated. As a result of this process, ecological surveys of the Hartsville site were conducted in 1972 and 1973. These surveys included vegetational surveys and an assessment of terrestrial wildlife and aquatic resources.

Beginning in January 1974 TVA initiated a comprehensive ecological survey and monitoring program for the Hartsville site. This program will serve to establish detailed baseline ecological characteristics and, in addition, serve as the preconstruction monitoring program. Elements of this program will be continued as necessary during construction and operation of the plant.

The ecological surveys conducted for the assessment of the site coupled with the ongoing programs will provide adequate data for evaluation of the environmental impacts of construction and operation of the plant.

This section is a general description of the environs of the Hartsville site.

2.7.1 Terrestrial - The Hartsville site has been used intensively by man for agricultural purposes for many years. Heavily fenced, it consists primarily of pasture, cropland and understocked woodland. Human activity, particularly cultivation, has continually disrupted plant and animal communities, leaving little of the area in a relatively undisturbed state. No rare or unusual species or

associations have been observed in studies to date. The concentration of black vultures on and near Dixon Island is considered important to the structure and function of the regional ecosystem.

2.7.1.1 Flora - The variety and complexity of herbaceous and woody plant associations of the area is an indication of its transitional nature. Vegetation types reflect difference due to location, microclimate, and cultivation. There is no observable clear-cut dominance at the Hartsville site due to the fact that most of the area is being used for agricultural purposes and dominance constantly shifts on a short-term basis accommodating numerous accessory species of plants.

2.7.1.1.1 Agricultural Flora - Approximately 1,940 acres of land will be utilized for the plant site. Cleared land occupies about 90 percent of the site area with the remainder being wooded. Eighty-five to ninety percent of the cleared land is pasture land or used for production of hay. The remainder of the land is corn, tobacco, or home vegetable gardens. Figure 2.7-1 presents the principal plant communities on the site. For the entire 2-county area, the two principal crops, both in terms of total acreage and economic importance, are corn and tobacco. This also applies to the area within five miles of the site (see Table 2.7-1). However, the majority of farm acreage in the general area as well as on the site is used for either pasture or hay production. Other crops such as soybeans, wheat, other

small grains and vegetables are also grown. Approximately 75 percent of the residents of the area have home gardens with a variety of vegetables being produced. For a tabulation of crops harvested in the 2-county area around the plant see Table 2.7-2. The information contained in this section is from data published in the 1969 U.S. Census of Agriculture and from a TVA reconnaissance of the area. The 1973 estimates were based on these sources.

2.7.1.1.2 Non-Agricultural - The Hartsville site is located in the Nashville or Central Basin physiographic province. The Basin is within the western mesophytic forest region.

The vegetation of the Hartsville site has been tentatively categorized into seven arbitrary zones: (a) limestone knolls with mostly closed woods but occasional open spaces; (b) open woods and deciduous tree rows primarily occurring along property lines; (c) pastures; (d) old fields; (e) cultivated areas; (f) fence rows; and (g) riparian woodlands.

(a) The limestone knolls have gentle slopes. The lower slopes of these knolls have black cherry-shagbark hickory-osage orange associations, and ground vegetation has an abundance of bitterweeds and spurge. On higher slopes there is an abundance of redcedar with hackberry, winged elm and occasionally chinquapin oaks. Here the ground vegetation is mostly grasses and wingstems with a good mixture of redcedar, oak, and hickory saplings. Osage orange is uniformly distributed throughout the slopes. On exposed rocks colonies of blue-green algae and lichens are consistently found and xerophytic moss is found on the sides. One species of fern, Ebony spleenwort, has been collected but many others have been

recorded for this type of physiographic region. On a single southwest-facing slope a few old (100 years or older) beech trees occur; these are accompanied by a few giant chinquapin oaks.

(b) The "open woods" type of vegetation is found primarily along property lines and ditch corridors. Elm and maple are the most important woody species, being present in both seedlings and transgressive layers. These areas are characterized by mature deciduous trees and by a paucity of shrubs and large herbs. The canopy is composed mainly of American elm, black oak, box elder, silver maple, black locust, and an occasional osage orange. The ground vegetation consists of sparsely distributed blackberry, dewberry, sumac saplings, poison ivy, and various tree seedlings.

(c) The pastures exhibit an abundance of panic grass, lespedeza, clover, and some broom sedge. Pure stands of broom sedge are found only in abandoned pastures. Fields that have not been brought under cultivation for 1-3 years (and not heavily grazed) exhibited the maximum number of species. Additional information is provided in Section 2.7.1.1.1.

(d) Common ragweed, giant ragweed, marsh elder, Mississippi horseweed, and false buckwheat are abundant in abandoned fields and waste places. In addition to the above, daisy fleabane is believed to be a prominent species during early summer. In places closer to ditches and creeks, horse nettle and ironweed show uniform distribution. Giant pigweed and jimson weed are frequently found around barnyards and ditches rich in cow manure. Areas that were not used for more than five years were dominated by golden rod, broom sedge, and aster in irregularly scattered clumps along with some grasses.

(e) As indicated in Section 2.7.1.1, the cultivated land is used primarily for corn, tobacco, and home vegetable gardens. Many of these cultigens escape and persist in fields and creek banks and may be mistaken for naturalized weeds. Okra, tomato, and turnip are found in some of the one-year-old fields. In addition to native species several introduced ornamentals like violet, petunia, four-o'clock, snow-on-the-mountain, and hibiscus occur.

(f) Barbed wire fences abound in the area. A good variety of fence row vegetation occurs. Fence rows that have not been cleared for many years exhibit honeysuckle to the exclusion of any other taxon. Poke, passion flower, coral berry and evening primrose are the dominant species on many fence rows with occasional mullein. Foxtail grass and false buckwheat, muscadine, black locust, and partridge pea were also abundant on roadside fence rows. Mulberry and redcedar are frequently found in these fence rows. Many of the fence posts support a rich growth of lichens and liverwort.

The diseases--powdery mildew on verbain and American elm, and leaf-spot on wingstem--were fairly extensive.

(g) The wooded areas on the banks of Dixon Creek and the Cumberland River are dominated by cottonwood, sycamore, and tulip tree. On the banks of the river and creek there was an abundant admixture of black willow saplings and fishing cane.

In general, only two areas of the site afford some semblance of native vegetation. The largest area is the wooded knolls adjacent and north of the plant site. The diversity of this area, although not documented, is expected to be low.

The wooded shorelines of Dixon Creek, Dixon Island, and Cumberland River constitute the major portion of riparian habitat at the site. This vegetation category is considered the most important habitat type at the site because of its suitability for a large number of plant and animal species.

2.7.1.2 Fauna - The Hartsville site, as noted previously, is primarily cleared farmland. As a result, the site has no unusual habitats. Removal of native vegetation and replacement with productive but less stable and diverse agricultural use has resulted in a decrease in diversity and numbers of native wildlife. No unique, rare, or endangered species are known to occur on the site; however, the unusual abundance of black vultures on and around Dixon Island is felt to be important to the existing ecosystem.

2.7.1.2.1 Domestic Fauna - As stated in section 2.7.1.1.1, within five miles of the plant site there are approximately 10,000 acres of land in pasture. This land supports approximately 5,900 head of cattle. About 5,000 of these are beef cattle with the remainder being dairy cattle. The dairy cattle classification includes cattle at commercial dairies, both grade "A" and grade "B" and individual cows maintained to produce milk for home use. The following tabulation gives information on milk cows and milk production in all of Smith and Trousdale Counties for 1973:

MILK PRODUCTION (1973)

County	Milk Cows on All Farms	Milk Production Million Pounds
Smith	4,050	28.1
Trousdale	2,203	18.4

Other livestock in the area include an estimated 4,000 hogs and 1,000 sheep.

2.7.1.2.2 Wildlife - The site has no very unusual habitats, primarily because of the relatively intense agricultural activities in the area. There are no river bluffs or substantial streams present (save the impounded Cumberland River and the inundated Dixon Creek flowing into it in the southeast corner of the area). The wooded knolls afford the largest terrestrial bird and small mammal habitat, although the diversity of such areas is typically not great.

The riparian woodland areas along Dixon Creek, the Cumberland River and Dixon Island constitute another important habitat type at the site in terms of being suitable for the greatest number of species. The riverbank of the Cumberland and the tributary streams is the most valuable habitat at the site. No marshy areas were noted nor do any extensive stands of mature timber exist.

It should be noted that nuclear plant development at the Hartsville site will result in minimal habitat losses; in addition, the opportunity for ecological development will be improved. The site is intensively farmed; very few natural communities exist and all that do exist are small. Large areas of the site will not be utilized for plant facilities. For the most part, the remaining areas will be allowed to return to the natural state. It is expected that these areas will improve from a stability and diversity standpoint.

In general terms, the wooded areas, although quite small relative to the size of the entire site, are expected to support a myriad of songbirds, herptiles, and small mammals. Fence rows and riparian areas also should support a variety of wildlife species with the shoreline wooded sections being the most important.

Game species such as quail, rabbit, and gray squirrel use the site although habitat conditions cannot support large populations of these species. Periodic inventories have been instituted to census breeding waterfowl and shorebirds frequenting the site. In terms of breeding waterfowl, two species are known to use the site. These are wood duck and giant Canada geese. Black vultures have been seen in large concentrations on the site--all on or near Dixon Island. Apparently these birds use Dixon Island as a staging area enroute to breeding territory nearby, as a feeding area during the breeding season, and as just a loafing site, especially for nonbreeders. None were seen during the winter inventories (October through February) indicating that use is predominately a spring-summer phenomenon.

Breeding birds would be most affected by development of the site. Ongoing monitoring programs as indicated in section 6 of the report will continue to document breeding birds at the site.

Rare or endangered birds which might occur on the site include several forms which, although they might rarely be seen on the site, almost certainly do not breed there. The Peregrine Falcon, Bald Eagle, Golden Eagle, Osprey, and Red-Cockaded Woodpecker all fall in this category.

The only mammal which might possibly occur on the site which has "endangered" status as determined by the Bureau of Sport Fisheries and Wildlife of the United States Department of the Interior, is the Indiana Myotis. This bat occurs most commonly in the caves of central Kentucky, southern Indiana, and Ohio, and in the Ozark Mountains.

Although the breeding sites and range of this species are not well known due to lack of habitat, it is highly unlikely that it might occur at the site.

Appendix F4 contains more detailed information concerning species occurrence at the Hartsville site.

2.7.2.1 Fish - Old Hickory Reservoir is located downstream of Center Hill, Dale Hollow, and Cordell Hull Reservoirs, which strongly influence it by cool water discharges and variable flows. Old Hickory has a rapid water exchange rate and at the site appears as a slightly broadened river. Site assessment studies initiated in the fall of 1972 and continued in the fall of 1973 by the Tennessee Technological University indicate, however, that the piscine community is not typical of either a stream or a lake habitat. With an estimated standing crop in the range of 149.5 to 826.9 pounds per acre, the species composition (Appendix F1 - Tables F1-2, F1-3, and F1-4) is dominated by gizzard shad, carp, and bluegill sunfish. Other abundant species include both black and white crappie, sauger, and freshwater drum. Although seldom taken in cove-rotenone samples, walleye are frequently taken by gill netting and electrofishing (Appendix F1 - Tables F1-5 and F1-6) as well as by sport fishing. With 35 species represented in recent samples, the species complex of the Dixon Creek area differs considerably from fish communities found in the Cumberland River during the latter 19th century (Appendix F1 - Table F1) prior to impoundment. These changes may also be attributable to other factors such as agriculture and industry.

National Marine Fisheries Service records indicate that Old Hickory Reservoir supports an annual commercial fish harvest of about 4.4 pounds per acre, most of which are buffalo, carp, and catfish.

A detailed discussion and compilation of the results of the 1972 and 1973 studies and preliminary results of ongoing studies are given in Appendix F1.

2.7.2.2 Other Aquatic Life - Five streams flow near or through the site area; Dixon Creek, located to the east of the site, is the largest of the streams. Two of the streams are tributaries of Dixon Creek and two flow into the Cumberland River.

The basic substrate types of the Cumberland River near the site consist of mud and detritus along the overbanks to gravel, rock, and hard rock bottom in midchannel. The substrates of the four smaller streams on the site consist of sand, gravel, and rocks, while the substrate of Dixon Creek is sand.

In May 1973, two limnological site surveys were made to assess the general biological conditions of the area. One survey was to collect general limnological data at three stations on the Cumberland River in the vicinity of the Hartsville site and the other was a preliminary benthic faunal survey of streams located near the site.

Further studies were initiated in January of 1974 by Tennessee Technological Unviersity under contract to TVA. These studies will serve to provide more detailed baseline data, and will also serve as a part of the preconstruction monitoring program. Appendix F2 contains the results of both sets of studies.

2.7.3 Pre-existing Environmental Stresses

2.7.3.1 Vegetation - The Hartsville site and surrounding area has been used intensively by man for agricultural purposes for years. Heavily fenced, it consists of pasture, cropland and understocked woodland. Human activities, particularly land cultivation and pasture utilization have continually interrupted natural ecological succession.

Introduced ornamentals and crop plants have escaped to edges and fence rows.

The variety and complexity of herbaceous and woody plant associations of the area can be construed to indicate man's activities. There is a constant shift of dominance on a short-term basis over most of the area due to a variety of crops and other use of open farm land.

It is probable that chemical agents have been used over major portions of the area during farm operations in the form of herbicides, pesticides, and fertilizer. All have some potential for creating environmental stress.

Shoreline areas along Dixon Creek, the Cumberland River, and Corley Branch have been cleared and used for agricultural purposes. Although previously altered by timber harvesting and partial cultivation, Dixon Island represents the largest remnant of riparian woodland. Wooded knolls north of the plant site represent the single largest area not being managed as open farmland. Its diversity, although not documented, is not expected to be great.

All the above factors constitute past and current environmental stresses placed on vegetation at the Hartsville site. Section 2.7.1 of this document describes the existing nature of site vegetation.

2.7.3.2 Wildlife - The description of pre-existing stresses on vegetation reflects the stresses placed on native wildlife species and to some degree on fish and waterfowl. The removal of native vegetation and replacement with productive but less stable and diverse

agricultural use has resulted in less cover and a lower variety of food for all native wildlife. The net result has been to decrease diversity and numbers of native fauna. Certain species, such as the mourning dove, have benefited while others have been essentially excluded.

2.7.3.3 Fish - Pre-existing environmental stresses in this section of the Cumberland River can be ascribed primarily to impoundment. As stated in Section 2.7.2, the species complex of this area is significantly different from that which was prevalent in the latter part of the 19th century, chiefly due to impoundment. These impoundment effects (altered temperature and flow regimes and water quality changes) are chronic and have altered the original fish assemblage to that which currently exists in the reservoir.

2.7.3.4 Water Quality - There is no evidence of pre-existing environmental stresses at the Hartsville plant site which have adversely affected water quality. The three domestic and two industrial waste discharges located between Cordell Hull Dam on the Cumberland River and Center Hill Dam on the Caney Fork River and the Hartsville plant site (see Table 2.5-6) treat their wastewater prior to discharge. The flows from these facilities are very small in comparison with the average and minimum daily flows of the Cumberland and Caney Fork Rivers. No significant deterioration in water quality has resulted from these waste discharges.

The recent closing of Cordell Hull Dam may cause flows from the dam turbines to have low dissolved oxygen concentrations during periods when stratification exists in the Cordell Hull Reservoir. The water quality effect of this discharge at the Hartsville site is expected to be minimal due to the distance between the dam and plant site (approximately 28.5 river miles) and the absence of large waste dischargers between the

dam and site. Reaeration of the discharge will occur during its flow to the plant site, and the small quantity of wastes added to the river in this reach will require little oxygen for assimilation.

Flows similarly low in dissolved oxygen concentration could occur in the Caney Fork River due to stratification in the reservoir above Center Hill Dam. These are expected to also have little impact at the Hartsville site.

2.7.4 Status of Ongoing Studies - As stated previously, the more detailed ecological studies were begun in January and March of 1974. They will be completed in March 1975.

Baseline or preconstruction investigations begun in late March 1974 included wildflower floristic inventories and reptile and amphibian searches in various habitats. These two phases of the overall program will be continued on through summer of 1974, with the complete site vegetation study including a quantitative plant ecological study and timber inventory to be completed in fall 1974. The herptofauna study will essentially be completed by the end of summer 1974 but present plans are to continue reptile and amphibian searches until late winter 1974-75.

On the basis of ongoing investigations, no rare and endangered reptiles or amphibians are thought to inhabit the area; nor have rare or unusual plants been identified to date. The bird survey is being conducted and will be completed by the first of September 1974. After a cursory field check of various habitat types, it is fairly certain that no rare or endangered avian species inhabit the site. Spring investigations indicate that migrating waterfowl use the Dixon Creek bottoms rather intensively when the agricultural land is flooded.

Mammal studies will be conducted in fall 1974 and be completed by the first of January 1975. Initial investigations of habitat types indicate that no unusual species inhabit the area.

In summary, the designated timetable will allow all vegetation studies to be completed by the end of November 1974; bird studies will be completed by September 1974; mammal studies will be completed by January 1975; and reptile and amphibian studies will be completed in March 1975.

Additional information is also included in Section 6 of this report.

Table 2.7-1

Agricultural Production (1973)
Within 5 Miles of the Site

Beef cattle	5,000	head
Dairy	900	"
Hogs	4,000	"
Sheep	1,000	"
Tobacco	500	acres
Pasture	10,000	"
Corn	400	"
Soybeans	300	"

Table 2.7-2

CROPS HARVESTED

1969*

Crop	Acres		Yield, Bu/Ac	
	Smith	Trousdale	Smith	Trousdale
Corn, grain	2,554	1,365	42	42
Corn, silage	487	202	NA	NA
Sorghums, grain	34	17	87	53
Sorghums, hay or silage	109	63	NA	NA
Wheat, grain	196	238	30	23
Other small grains	239	339	NA	NA
Hay, excluding sorghum	14,324	6,735	1.5 (a)	1.5 (a)
Tobacco	1,820	1,040	1,988 (b)	2,024 (b)
Potatoes, Irish and sweet	152	41	NA	NA
Vegetables, sweet corn or melons for sale	26	13	NA	NA
Berries for sale	2	5	NA	NA
Orchards	15	NA	NA	NA
Other crops	503	396	NA	NA
Greenhouse products under glass	2,002 (c)	NA	NA	NA

*Tennessee Census of Agriculture, 1969.

(a) Tons/acre
(b) Lbs/acre
(c) Sq ft.

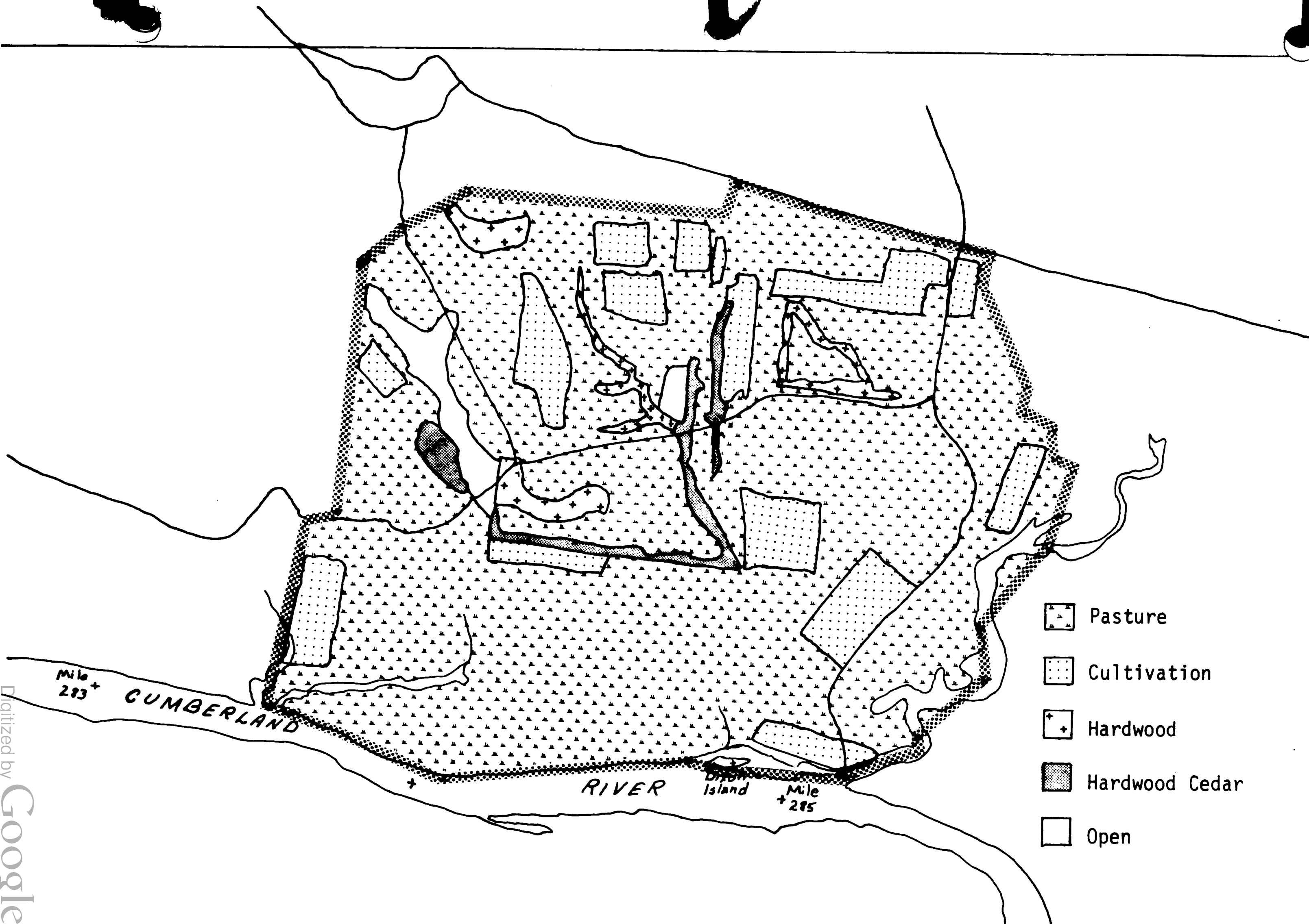


Figure 2.7-1

PRINCIPAL PLANT COMMUNITIES

2.8 Background Radiological Characteristics

Although background radiological levels in the immediate vicinity of the site have not been specifically measured it is expected that they would not vary significantly from the 115 to 140 mrem/year prevalent in the southeastern United States.* Natural background radiation levels and concentrations of radioactive materials found in important biota, soil, regional surface water, and local ground water will be established as a part of the preoperational surveillance program as outlined in Section 6.1.5. This program will be initiated approximately two years before plant operation. Baseline information on radioiodine in cows' milk will also be established.

* Estimate of Ionizing Radiation Doses in the United States, U.S. Environmental Protection Agency Report ORP/CSD 72-1, 1972.

3.1 External Appearance

The midpoint of the Hartsville complex is located approximately 2,000 feet north of the Cumberland River (see section 2.1 for a detailed discussion of the site and location). All principal structures are located at four distinct levels. The building complex and cooling towers for both plants rest on plateaus with finished grades at elevations of 545 and 530 feet above sea level, respectively. The transmission switchyards for plant A and plant B lie on separate planes having finished elevations at 520 and 550 feet above sea level, respectively.

The two plants will be located between rolling, wooded land forms rising approximately 305 feet above the grade of the plants to the north and the Cumberland River to the south which falls from the plant grade 95 feet. The east and southeast boundaries of the site are generally established by Dixon Creek which forms the only point of visual penetration to the site from Highway 25. The plants' major structural forms are located between the natural hill to the north and the cooling towers to the south. The natural and manmade forms establish a visual space in which the two plants are to be sited. The cooling towers will create a visual backdrop which will help unify the structural forms of the two plants and reduce their apparent scale in relation to the site. The materials chosen for the structural forms will be selected to keep the structural masses simple and clean in appearance.

The entry and major visual contact with the plants follow the natural features of the terrain along Dixon Creek. The visitors and employees

will approach the site along the base of the hill and swing to a point on the hill where the two plants can be seen below. The office building and service building will act as transitional elements both physically and functionally for personnel entering the plant complex. The nuclear island and the turbine buildings themselves will set free on the plane between the cooling towers and the sloping hill in which the office building and service building are integrated. The natural setting, coupled with additional landscaping, will provide a harmonious setting for the structural forms.

An aerial perspective of the complex with major structural elements is presented as figure 3.1-1. Perspectives of the complex showing major structural elements, as viewed from various ground locations about the site are given in figure 3.1-2 through figure 3.1-4. Figure 3.1-5 consists of a view-identification map. Figure 3.1-6 relates the plant layout to the site topographical map presented in section 2.1. A site plan showing the proposed site boundary, plant arrangement, and selected effluent discharge points is provided in figure 3.1-7. An enlarged plan view depicting building layout, cooling tower arrangement, switchyard location, and associated effluent release points is given in figure 3.1-8.

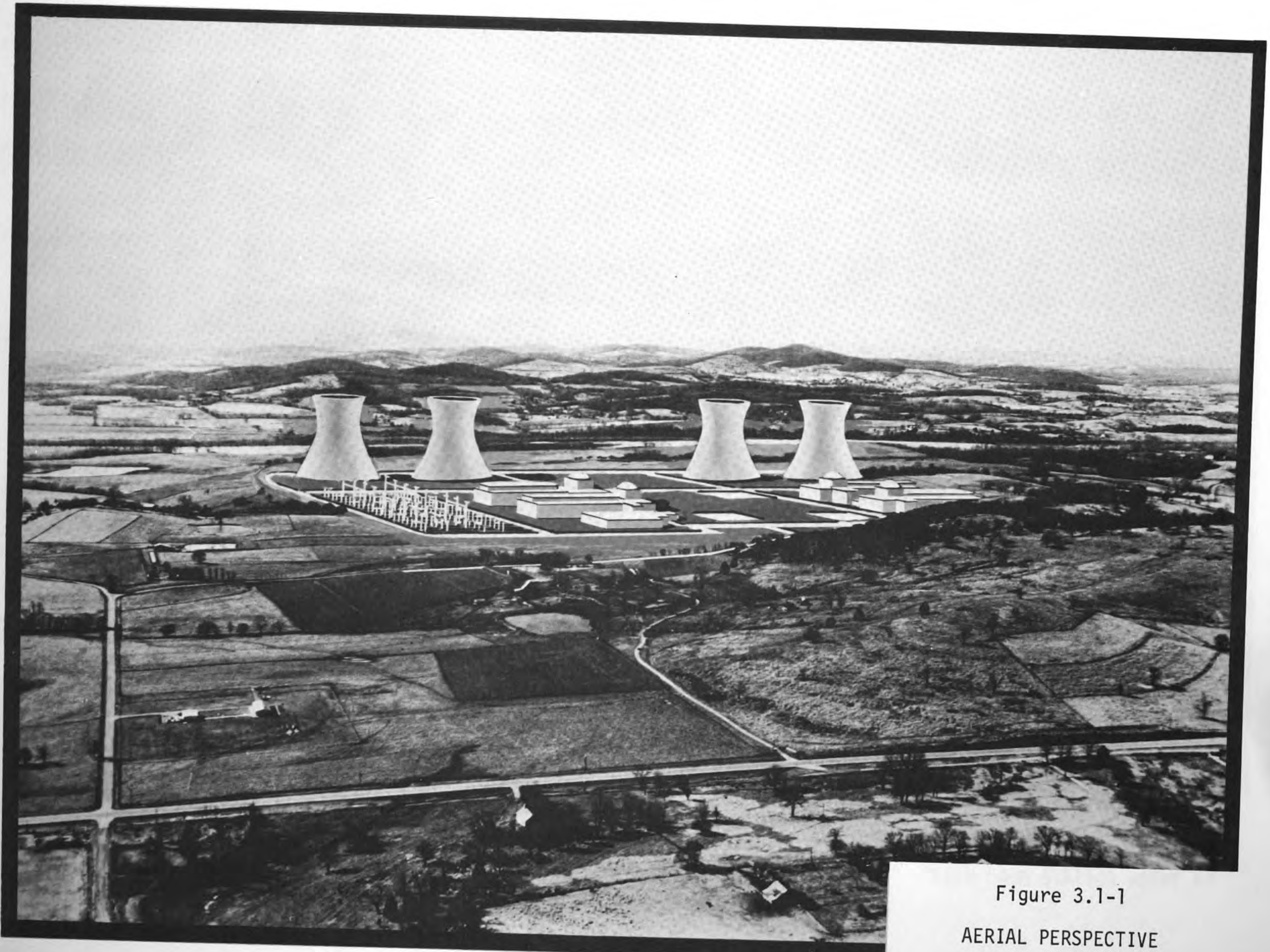


Figure 3.1-1

AERIAL PERSPECTIVE

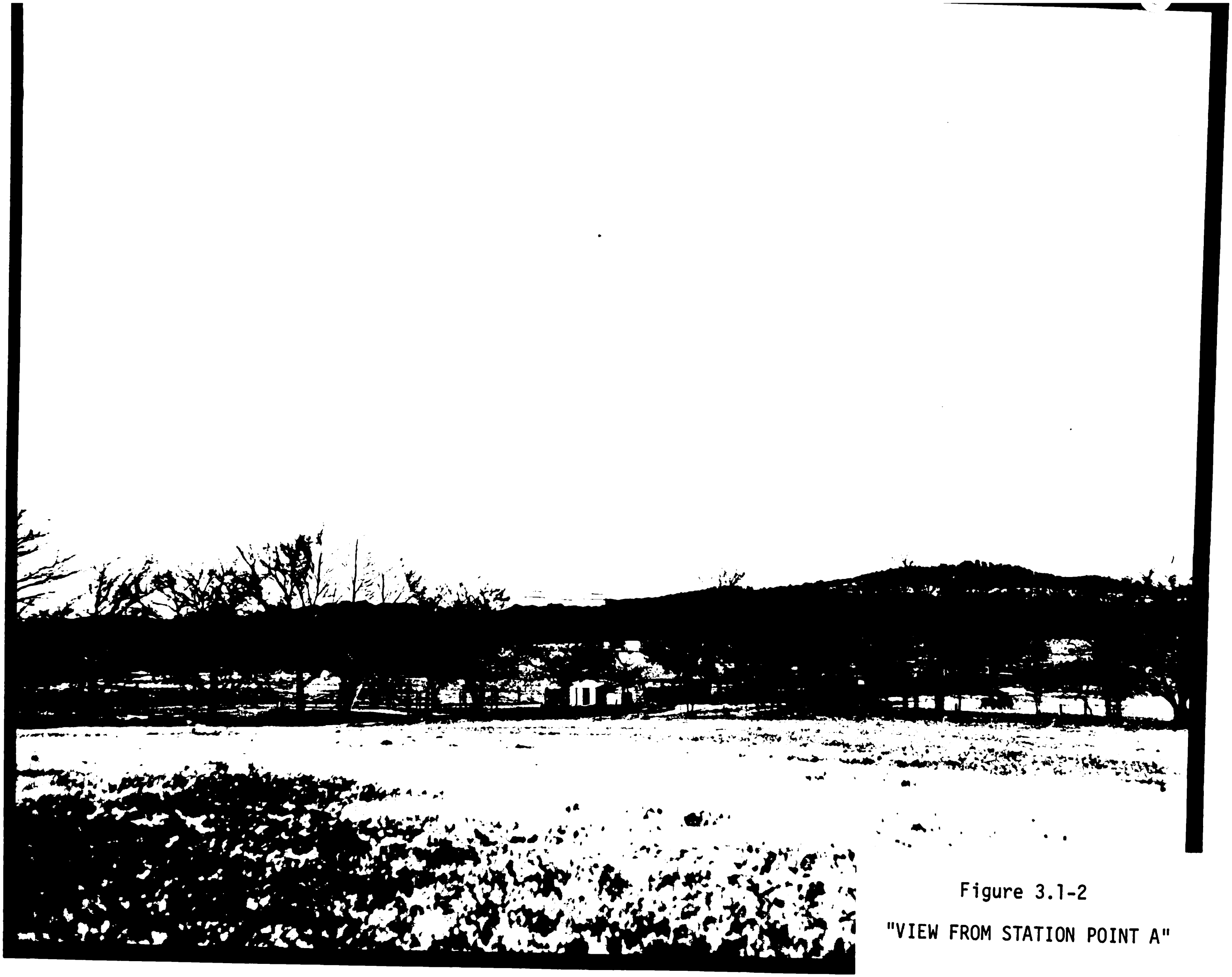


Figure 3.1-2

"VIEW FROM STATION POINT A"

Figure 3.1-3

"VIEW FROM STATION POINT B"

Figure 3.1-4

"VIEW FROM STATION POINT C"

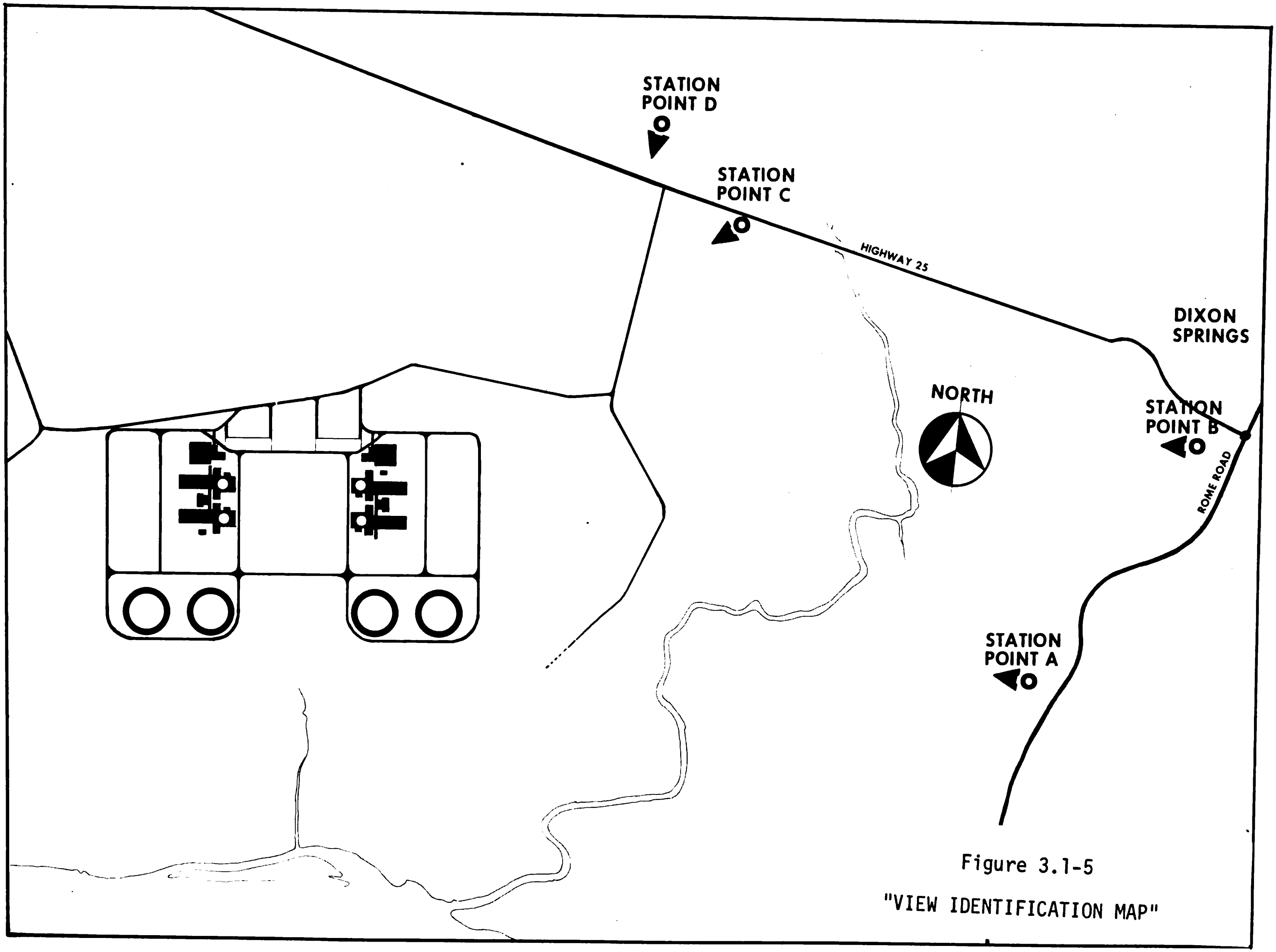


Figure 3.1-5

"VIEW IDENTIFICATION MAP"

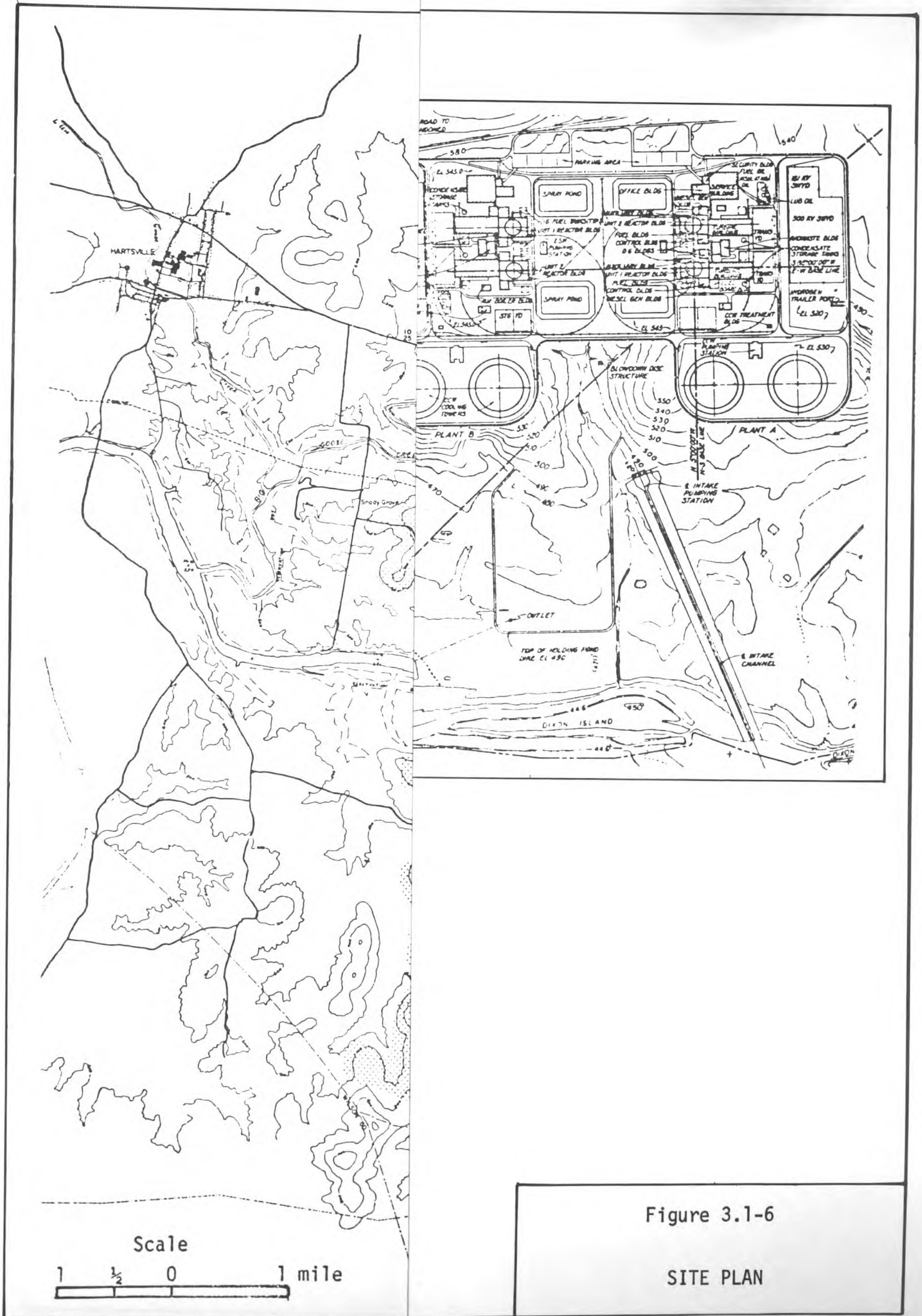
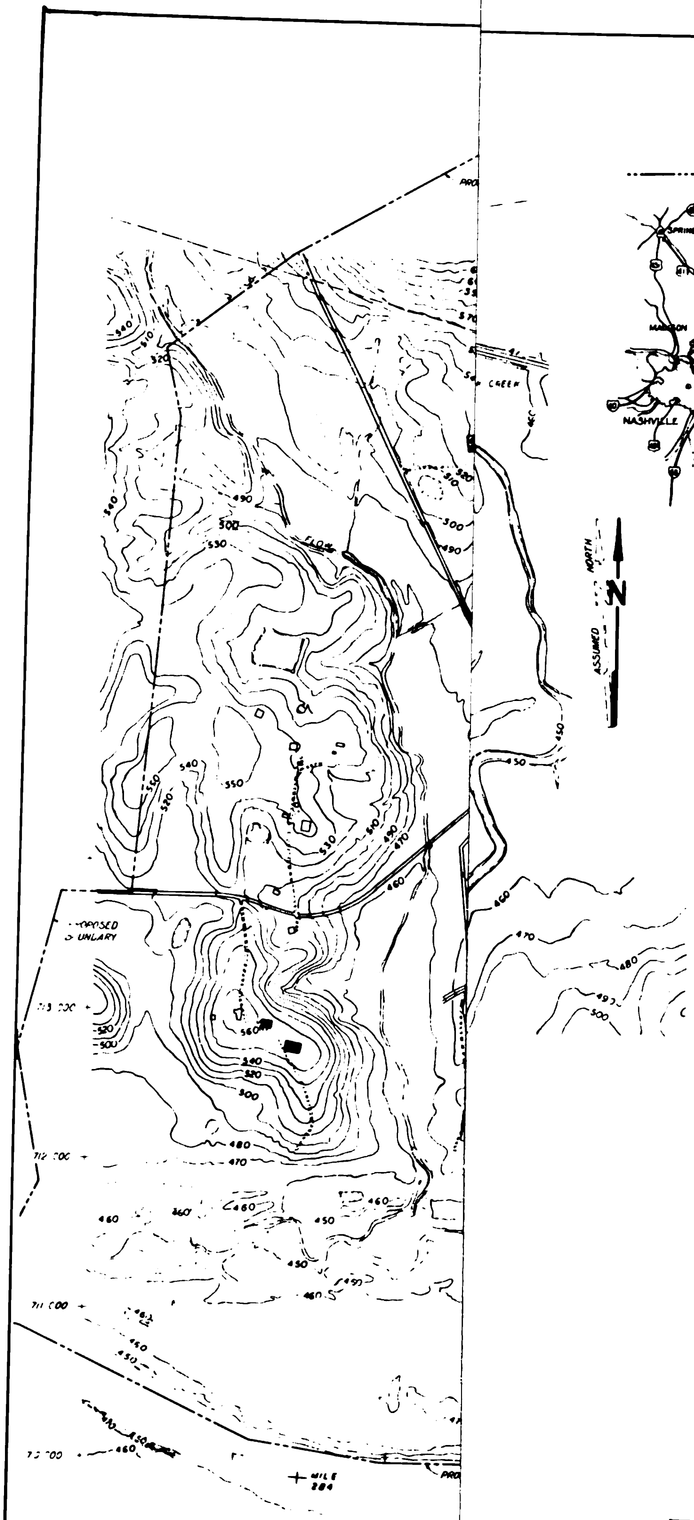
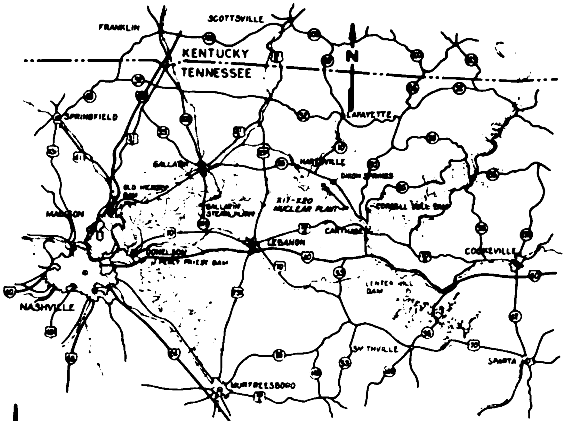


Figure 3.1-6

SITE PLAN





LOCALITY MAP

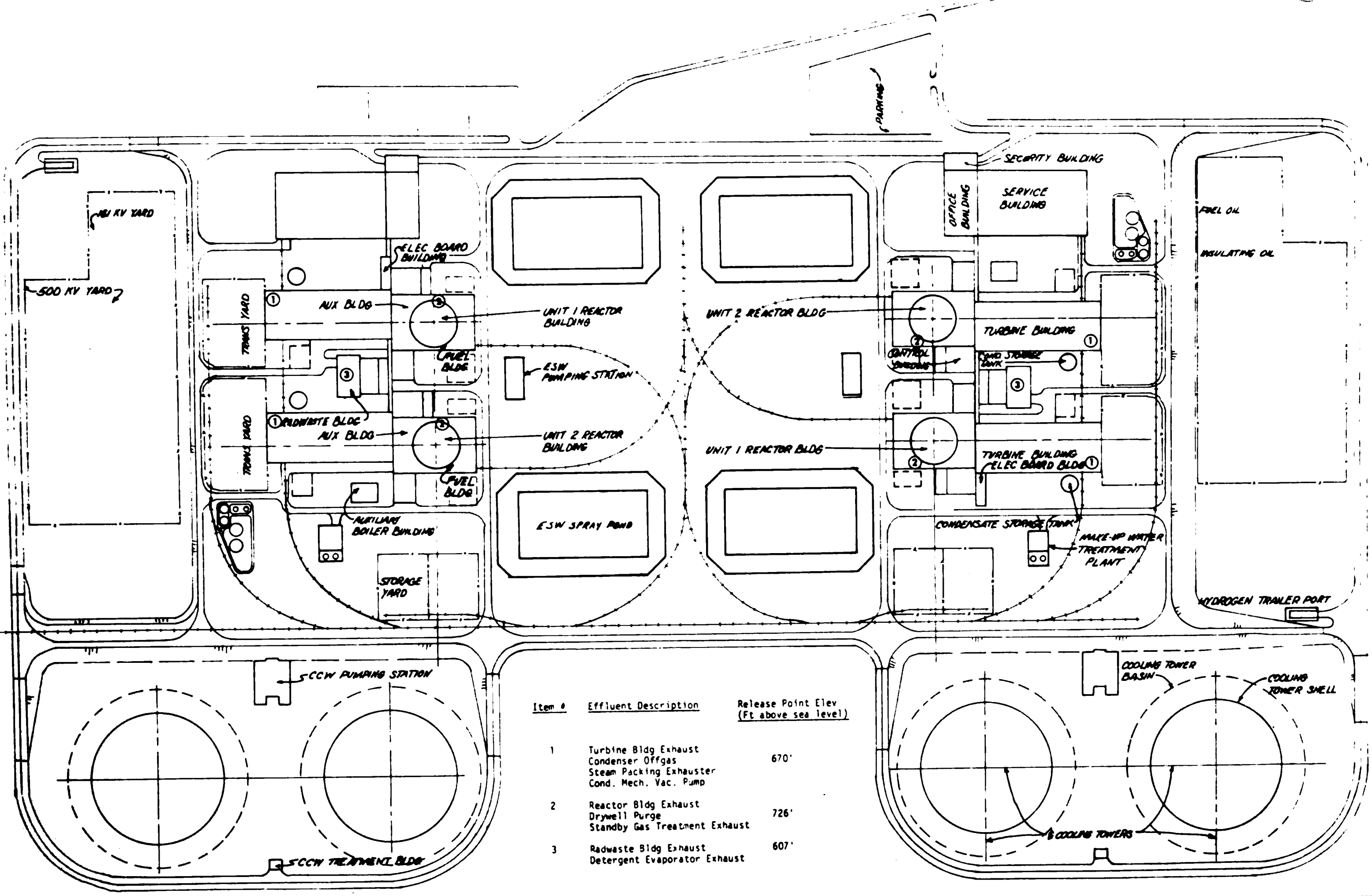
SCALE OF MILES

1. TOPOGRAPHY TAKEN FROM KELSH TWO FEET CONTOUR TOPOGRAPHY DATED 1973, AND REDUCED. CONTOUR INTERVAL SHOWN IS 10 FEET, EXCEPT AS NOTED.
2. FOR CLARITY, BUILDINGS HAVE BEEN IDENTIFIED ONLY ONCE FOR BOTH PLANTS A & B. THE BUILDINGS AND BUILDING LAYOUT FOR BOTH PLANTS ARE IN MOST PART, IDENTICAL WITH PLANT B ROTATED 180° WITH RESPECT TO PLANT A. THE OTHER BUILDINGS ARE OPPOSITE HAND (SECURITY, OFFICE, SERVICE, ETC.)
3. TENNESSEE LAMBERT COORDINATES ARE INDICATED IN THE MARGIN.
4. THE TENNESSEE LAMBERT COORDINATES FOR THE INTERSECTION OF THE N-S AND E-W BASE LINES ARE: X-1,975,420.30 AND Y-714,156.67.

SCALE 400 0 400 800 FEET

Figure 3.1-7

PLANT LAYOUT



Item #	Effluent Description	Release Point Elev (Ft above sea level)
1	Turbine Bldg Exhaust Condenser Offgas Steam Packing Exhauster Cond. Mech. Vac. Pump	670'
2	Reactor Bldg Exhaust Drywell Purge Standby Gas Treatment Exhaust	726'
3	Radwaste Bldg Exhaust Detergent Evaporator Exhaust	607'

Figure 3.1-8

GASEOUS EFFLUENT RELEASE POINTS

3.2 Reactor and Steam Electric System

3.2.1 Nuclear Steam Supply System - Two essentially identical twin-unit plants will be situated on the same plant site. The nuclear steam supply will be designed and supplied by the General Electric Company. TVA is the architect-engineer for the plants, but General Electric's Standard Reactor Island Design (STRIDE) will be incorporated in the overall design. STRIDE includes the design of the following buildings and all the systems therein: reactor building, fuel building, auxiliary building, control building, diesel generator buildings, and radwaste building.

Each of the four boiling water reactor units (BWR-6) is rated at 3579 MW core thermal power and each of the turbogenerators at 1,220 MW electrical power. The in-plant electrical power consumption will be approximately 38 MWe. Design power is 3,758 MWt and 1,285 MWe. The BWR/6 vessels are 238 inches diameter and contain a core made up of 732 fuel assemblies and 177 control rods.

The reactor containment is the General Electric Mark III concept with a free-standing steel containment surrounded by a concrete shield building.

A schematic diagram and table of operating conditions for the nuclear steam supply system is shown on figure 3.2-1.

3.2.2 Fuel Description - Fuel for the reactor core will consist of slightly enriched (average initial fuel load enrichment 1.97 wt%) uranium dioxide pellets sealed in Zircaloy-2 tubes. These tubes (or fuel rods) are assembled into individual fuel assemblies. A fuel assembly consists of a fuel bundle and the channel which surrounds it. A fuel bundle

contains 63 fuel rods and one water rod that are spaced and supported in a square (8 by 8) array by an upper and lower tie plate. Reactor core control will be achieved by 177 moveable, bottom entry, stainless steel control rods containing boron carbide (B_4C).

Each fuel rod will consist of high density (95 percent theoretical density) cylindrical pellets of sintered UO_2 having a total active height of 148 inches. The Zircaloy-2 cladding tube will have an outside diameter of 0.493 inch and an external length of 176 inches. The fuel pellets are stacked in this tube which is evacuated, backfilled with helium, and sealed by welding Zircaloy end plugs in each end. A plenum is provided at the top of the rod which contains a plenum spring to prevent movement of the fuel during shipping and handling; the plenum area provides a space for fission gases to accumulate.

Four different U^{235} enrichments will be used in the fuel assemblies to reduce the local power peaking factor. Gadolinia-bearing pellets will be used in some of the higher enrichment rods as a burnable poison. The initial fuel loading will contain 304,235 pounds of uranium per unit.

<u>3.2.3 Steam and Power Conversion System</u> - The steam and power conversion for each of the four units is designed to produce electrical power from heat produced in the reactor. The waste heat is rejected to the atmosphere through the plant's cooling water system.

The major components of the steam and power conversion system are turbine generator, main condenser, steam jet air ejectors, vacuum pumps (for initial evacuation of the main condenser), turbine seal system, turbine bypass system, hotwell pumps, condensate demineralizers, condensate booster pumps, reactor feed pumps, reactor feed pump turbines, reactor feed pump turbine condensers, feedwater heaters, heater drain pumps, and condensate storage system.

Main steam from the reactor flows to the high pressure turbine through four main steam lines. Steam is diverted from the main steam for reheating, for generation of essentially nonradioactive steam during startup, for operation of the reactor feed pump turbine during the startup and low load operation, and for motive steam for operation of the steam jet air ejectors. The steam is expanded through the high pressure turbine and then exhausted to the moisture separator reheaters. The moisture separator section removes the moisture from the steam and the two stage reheaters superheat the steam before it enters the low pressure turbines. The steam expands through the low pressure turbines and exhausts into the multipressure condenser where it is condensed, deaerated, and returned to the cycle as condensate. The heat rejected in the main condenser is removed by the circulating water system (see section 3.4).

The first stage reheater is supplied with steam from an extraction point. The second stage reheater is supplied with main steam from ahead of the turbine stop valves. The reheater drains (condensed heating steam) cascade to the highest pressure (number one) feedwater heater.

Condensate from the hotwell of the highest pressure condenser zone is transmitted by the hotwell pumps through the parallel arrangement of gland steam condenser, steam jet air ejector condensers, and off gas condensers, through the full flow condensate demineralizer, and into the suction of the condensate booster pumps. The condensate booster pumps pump the water to the reactor feed pump turbine condensers, four stages of feedwater heaters, and into the suction of the reheater feed-water pumps. These pump the water forward through two stages of

feedwater heaters and into the inlet of the nuclear boilers. Heat for the feedwater heating cycle is supplied by the moisture separator reheater drains and by steam from the turbine extraction points.

The turbines, manufactured by Brown Boveri Corporation, are 1,800-rpm tandem compound, four-flow machines with 52-inch last stage blades, which drive a 1,430,000 KVA, 1,800-rpm, direct-connected, 24,000-volt, 3-phase, 60-Hertz, conductor-cooled synchronous generator.

A turbine bypass system capable of bypassing a portion of the main steam flow directly to the condensers is provided for startup and load changing operations.

	PRESSURE (psia)	FLOW (lb hr)	TEMPERATURE (°F)	ENTHALPY (Btu lb)
1. CORE INLET	1075	105×10^6	533	528
2. CORE OUTLET	1049	105×10^6	550	644
3. SEPARATOR OUTLET (STEAM DOME)	1040	15.4×10^6	549	1191
4. STEAM LINE (2ND ISOLATION VALVE)	985	15.4×10^6	543	1191
5. FEEDWATER INLET (INCLUDES RETURN FLOW)	1065	15.5×10^6	420	398
6. RECIRC PUMP SUCTION	1045	26.7×10^6	533	528
7. RECIRC PUMP DISCHARGE	1329	26.7×10^6	534	529

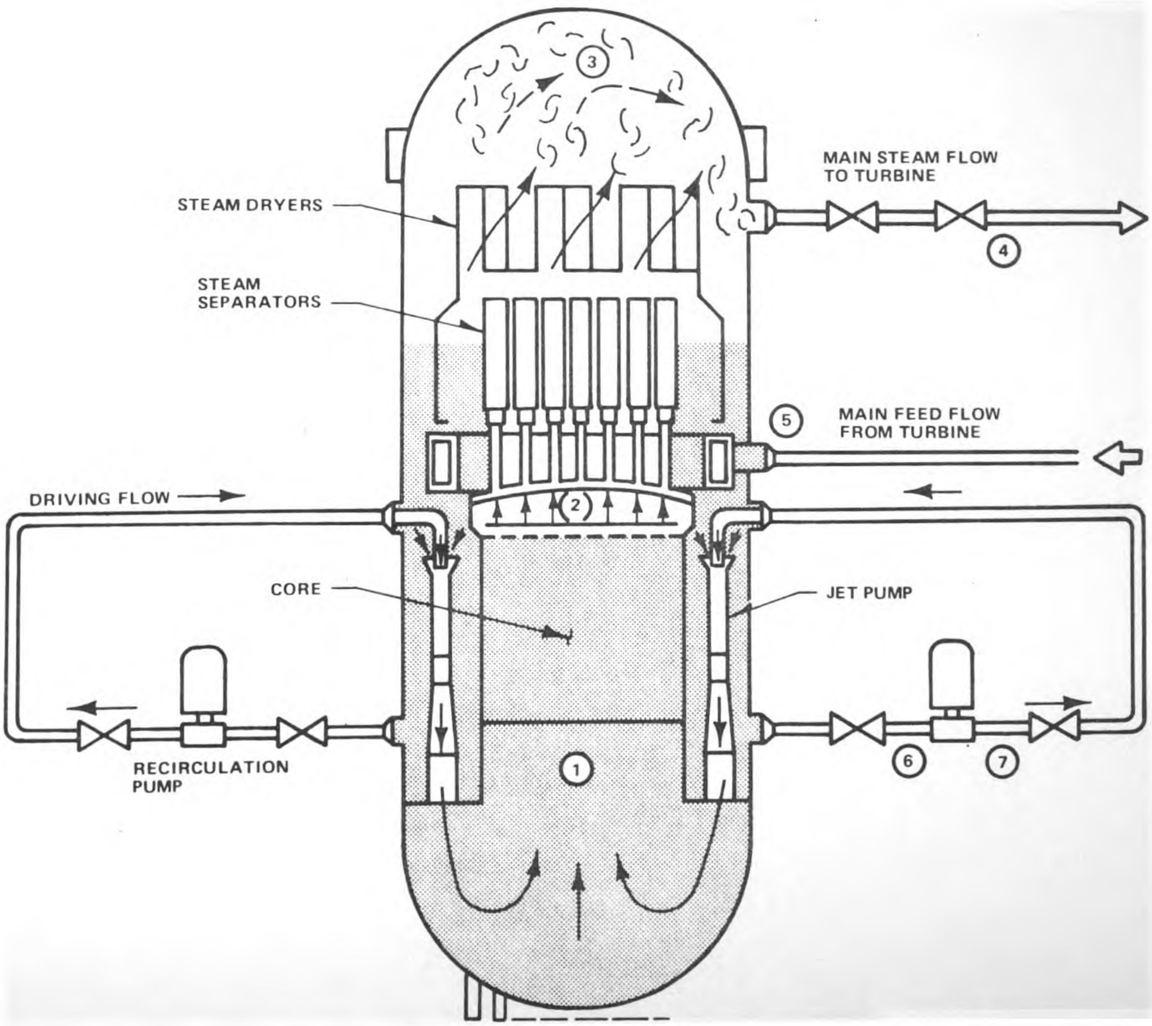


Figure 3.2-1

OPERATING CONDITIONS OF THE BOILING WATER REACTOR

3.3 Plant Water Use

3.3.1 General Use - Water at the proposed Hartsville Nuclear Plant will be used for a variety of purposes. Major uses of water will be for making steam to drive the turbines, for the condensing and cooling systems, and for emergency cooling and fire protection systems. Smaller smounts will be used for sealing bearings, for potable water, service water, and for mixing of various chemicals used in the plant.

Water use during normal full load operation for one plant is shown in figure 3.3-1 and tabulated in Table 3.3-1. The total water use of both plants will be twice the amounts shown as the two plants are identical and will have approximately the same water use needs. A tabulation of water use needs (per plant) for other than normal full load operation is shown in Table 3.3-2.

All water needs except possibly the potable water needs will be taken from the Cumberland River through a common intake for both plants. A description and discussion of the intake system is contained in section 3.4.2. The potable water supply has not been located for the plants at this time. It is possible that potable water may be purchased from local utilities if it is available, or other appropriate supply means may be employed. In any case, this will be a rather small amount of water (approximately 12,000 gallons per day per 2-unit plant) in comparison to the other plant water needs.

The total water required for the plants will be dependent on the following factors:

1. The amount of cooling tower blowdown required to maintain cooling water within water quality limits which would be necessary for proper tower operation.
2. The amount of water which is recycled or cascaded in plant operation. Recycling or cascading of water will be done whenever and wherever it is technically and economically feasible within the limits of inplant water inventories.
3. Evaporation rates from essential service water spray ponds and condenser cooling water cooling towers.

Waste water which cannot practically be recycled or reused will be discharged through a diffuser and mixed with the Cumberland River. Details of the discharge structure, expected flow, water quality of the effluent and other data are discussed in sections 3.4.3, 5.4.1, and 5.5.1.

3.3.2 Consumptive Use - Water which is consumptively used, that is, taken and used by the plant and not returned to the source, consists primarily of the water lost by evaporation from the condenser circulating water cooling towers and smaller losses from the essential service water spray ponds. Other small losses include water contained in waste sludges and partially dewatered wastes which are buried or disposed of otherwise, and wastes which are vaporized to the atmosphere.

Table 3.3-1

Water Use

Normal Full Load Operation

		GPM (per 2-unit plant)
1.	Screen wash	240 (when used)
2.	Fire protection	0
3.	Condenser cooling water makeup	50,000
4.	Essential service water makeup	1,000
5.	Condenser cooling water	900,000
6.	Cooling tower evaporation	25,000
7.	Cooling tower drift	90
8.	Raw cooling water	36,000
9.	Condenser cooling water blowdown	25,000
10.	Essential service water	28,000
11.	Essential service water blowdown	500
12.	Essential service water evaporation	500
13.	Service water	Dependent on System Requirements 1,720 GPM Maximum
14.	Makeup treatment plant	120
15.	Drains to station sump	600
16.	Roof drains	Dependent on Rainfall
17.	Yard drains	Dependent on Rainfall
18.	Potable water	8
19.	Sanitary waste	8
20.	Liquid radwaste	31
21.	Package radwaste	4
22.	Recycle to condensate storage	27
23.	Discharge diffuser	25,500

Table 3.3-2

Water Use

Accident or Emergency Conditions

		GPM (per 2-unit plant)
1.	Screen wash	240 (when used)
2.	Fire protection	8,000 maximum
3.	Condenser cooling water makeup	--
4.	Essential service water makeup	1,000
5.	Condenser cooling water	--
6.	Cooling tower evaporation	--
7.	Cooling tower drift	--
8.	Raw service water	--
9.	Condenser cooling water blowdown	--
10.	Essential cooling water	57,200
11.	Essential service water	500
12.	Essential service evaporation	500
13.	Service water	Dependent on System Requirements 1,720 maximum
14.	Makeup treatment plant	--
15.	Drains to station sump	600
16.	Roof drains	Dependent on Rainfall
17.	Yard drains	Dependent on Rainfall
18.	Potable water	8
19.	Sanitary waste	8
20.	Liquid radwaste	160
21.	Package radwaste	60
22.	Recycle to condensate storage	100
23.	Discharge diffuser	--

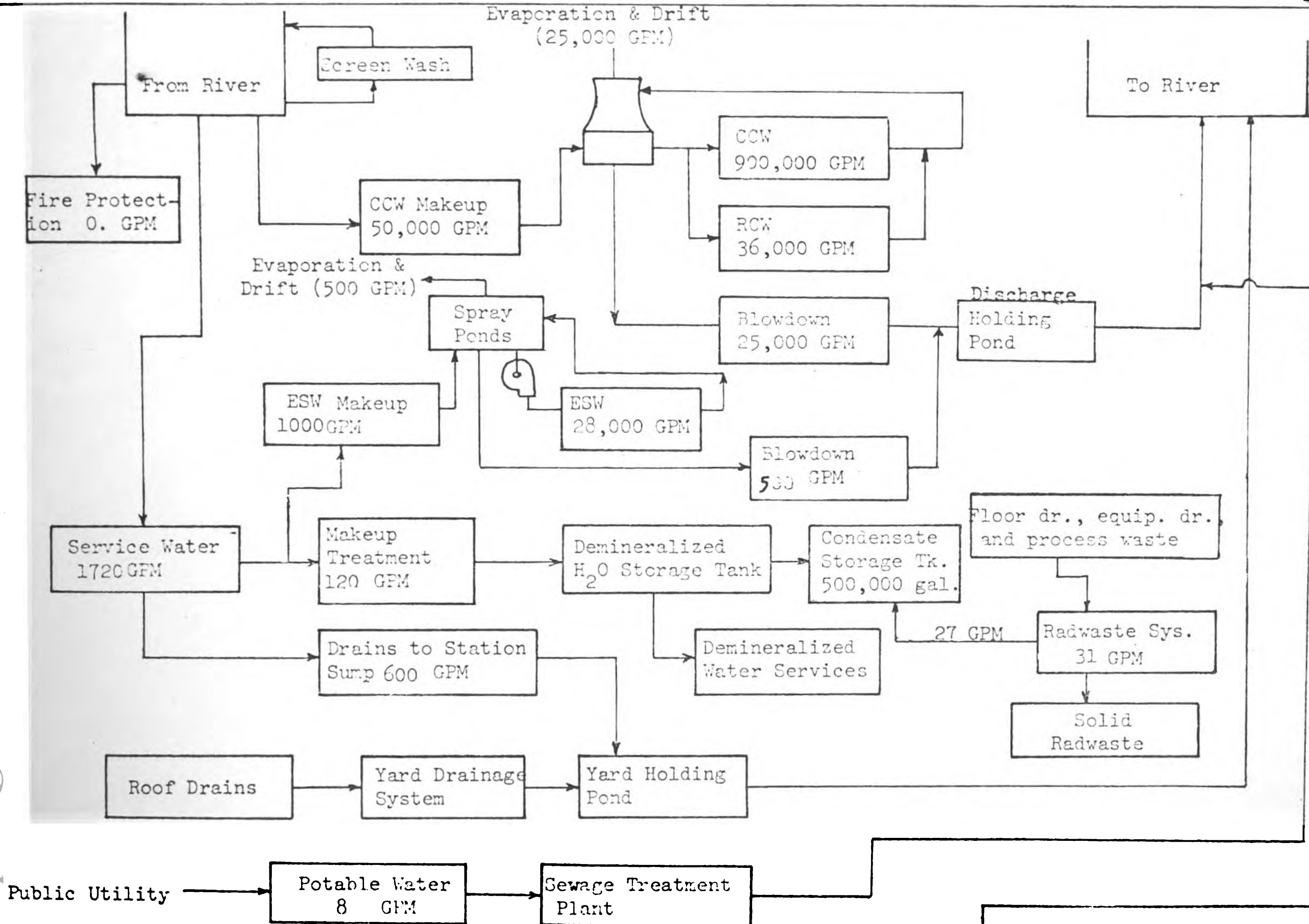


Figure 3.3-1

PLANT WATER USE DIAGRAM

3.4 Heat Dissipation System

3.4.1 Natural Draft Cooling Towers - During the operation of the the Hartsville Nuclear Plants, cooling water will be required for operation of the condensers and other heat exchange equipment. In order to meet the cooling requirements at the Hartsville Nuclear Plants and at the same time reduce impacts to the environment, TVA proposes to install closed-cycle natural draft hyberbolic cooling towers. (Section 5.1 discusses the environmental impacts due to heat dissipation.) This type of condenser cooling water system will cycle cool water from the cooling towers through the condensers and discharge the warmed water back to the cooling towers in a closed system rather than discharging to the river. Figure 3.4-1 provides the schematic arrangement for the closed-cycle system.

The plant will be designed for four natural draft, wet-only cooling towers arranged as shown in figure 3.1-7. Each tower will be approximately 400 feet in diameter and 460 feet high and will be spaced about one tower-width apart.

For each unit, approximately 450,000 gal/min of cooling water from the cooling towers will circulate through the main condenser and raw cooling water system (RCW). The temperature of the water flowing through the main condenser and RCW system will be raised by approximately $36^{o}F$. in removing 8.1×10^{9} Btu/h from each unit when operating at normal full load. Each tower will normally have about 2.0×10^{8} lb/h of air drawn through it. In the operation of cooling towers, a certain portion of the circulating water is continuously lost as a result of

evaporation, small leaks, drift, and blowdown. Drift is fine water droplets entrained in the warm air flow and physically carried out of the tower. Based on recent tower manufacturers' test results,[1,2] drift is estimated to be not greater than 0.01 percent of the circulating water flow rate, or 45 gal/min (0.1 ft^3/s) per tower. Evaporation is estimated to average about 12,500 gal/min (28 ft^3/s) per unit. The maximum evaporation rate is expected to total about 14,500 gal/min (32 ft^3/s) per unit.[3] The blowdown rate will be approximately equal to the evaporation rate so as to maintain two times the concentration of dissolved solids in the makeup water.

Makeup will be withdrawn from the Cumberland River to replace the water lost by evaporation, drift, and blowdown. Makeup volume will average about 25,500 gal/min (57 ft^3/s) per unit, with a maximum value of about 29,500 gal/min (66 ft^3/s) per unit. Only the blowdown is returned to the river, so the consumptive use of water is about 13,000 gal/min (28 ft^3/s) per unit average and about 14,500 gal/min (32 ft^3/s) per unit maximum.

Temperature of the blowdown discharged to the reservoir will average about 65°F. in the winter, 74°F. in the spring, 84°F. in the summer, and 74°F. in the fall. The increase in temperature between makeup withdrawn from the reservoir and blowdown discharged to the reservoir varies widely with ambient air temperature. The highest monthly average value of this increase is 20.5°F. which occurs in March. The annual average increase is 16.5°F. Time required for passage of water through the condenser is estimated to be 15 to 20 seconds.

3.4.2 Intake System

3.4.2.1 System Purpose - The intake system is designed to provide the plants water requirements for the Service Water System, Fire Protection System, the Condenser Circulating Water System and other miscellaneous systems. The Service Water System provides the makeup water for the essential service water spray pond (see section 3.4.4). The location of the various features of the proposed intake system are shown in figure 3.4-2.

3.4.2.2 System Description - A deepwater, mid-river intake will be used at the Hartsville Nuclear Plant. The intake system will be designed to serve the water requirements of both plants. The system provides water for the following service: fire protection, makeup to the Essential Service Water System, and makeup to the Condenser Circulating Water System. The intake system will consist of an inland pump station, a 2500' channel, a shoreline dike, and submerged pipes to connect the inland channel with the Cumberland River. The layout of the intake system on site is shown in figure 3.1-7. Details of the system are shown in figure 3.4-2.

The deep water intake will be accomplished by constructing a dike across the mouth of the intake channel and extending six corrugated steel pipes through the dike for approximately 200 feet to near the center of the river. The end of the intake pipes will have approximately 20 feet of water above them when the reservoir level is down to elevation 442. The invert of the pipes will be approximately 6 feet above the bottom of the channel. They will be supported on a bed of crushed rock. The pipes will be held in place with a concrete anchorage system designed to resist the uplift forces caused by barge tows passing overhead. The anchorage system will consist of concrete

blocks located on each side of the pipe and connected by a steel strap across the top of the intake pipe.

The earthen dike will separate the intake channel from the Cumberland River. The dike will be constructed so that the continuity of the original shoreline is maintained. The dike will have riprap covering both sides to prevent erosion.

The intake channel will extend from the shoreline dike to approximately 2500' inland. The open channel from the dike will have base width of 20 feet and will be cut out of both earth and rock (see figure 3.4-2). The earth sides slopes are assumed to be 2.5 feet horizontal to 1 foot vertical. Rock side slopes are assumed to be 1 foot horizontal to 10 feet vertical. A berm 10 feet wide will be excavated between the top of the rock cut and the toe of the earth slope. The earth slopes will be grassed. Riprap will be placed on the earth slopes for 2 feet below normal minimum pool level to 3 feet above normal maximum pool level. The water depths and average velocities for various sections of the intake channel with the reservoir at the normal minimum pool level and with normal plant water requirements are presented below.

Channel Description (See Figure 3.4-2)	Water Depth (Ft)	Velocity (ft/s)
Intake Pipes	-	1.53
Earth Cut	7	1.08
Rock Cut	9	1.52
Rock Forebay	16	0.15

The pump station will be located inland at the end of the 2500' open channel (see figure 3.4-2). This particular location for the

pump station was selected in order to minimize the size of the structure and balance the cost of electrical and mechanical conduits against channel excavation, while still avoiding other major site features (e.g., slopes from plant grade, discharge pond dike, etc.). The inland pump station will have eight intake openings, with four openings furnishing each plant. The top of each opening will be at elevation 440 and the bottom at elevation 426. The maximum velocity of flow will be approximately 0.5 feet per second through each of the openings. The openings will be followed by vertical traveling screens which have 3/8-inch opening mesh. The maximum velocities through the screens will be about 0.91 feet per second. All water taken into the pumps station will pass through 1/8-inch strainers after passing through the traveling screens.

Construction of the intake system will entail earth and rock excavation and displacement, especially during construction of the intake channel. There will be approximately 296,600 cubic yards of earth excavation and 31,600 cubic yards of rock excavation. Approximately 4800 cubic yards of riprap and 1600 cubic yards of filter blanket material will be required on the earth slopes for protection from erosion.

3.4.3 Discharge System

3.4.3.1 System Purpose - The discharge system receives blowdown water from the Essential Service Water (ESW) system and the Condenser Cooling Water (CCW) system and miscellaneous wastes from both plants and conveys it to the river where it disperses the blowdown into the river. The location of the various features of the discharge system is shown in figure 3.1-7.

3.4.3.2 System Description - The blowdown water from the ESW and CCW systems, for each plant, is piped to a Blowdown Stilling Structure (BSS). The purpose of this reinforced concrete structure is to combine the blowdown from each plant and to reduce the water velocity. A paved ditch carries the blowdown water from the BSS to a large pond. The ditch is paved to prevent erosion. The pond will have a surface area of from 30 to 35 acres. An outlet structure in the pond will release the water to enter an underground pipe to carry the water to a corrugated steel diffuser pipe on the riverbed.

The multiport diffuser pipe will extend perpendicular from the shoreline. A bedding of crushed stone will be below the pipe. An anchorage system will restrain the pipe against uplift forces caused by barge tows passing overhead. The anchorage system will consist of concrete blocks located on each side of the diffuser and connected by a steel strap across the top of the diffuser pipe. A valve on the underground pipe will control the flow so as to allow a relatively constant head to be maintained. The head will cause the discharge velocity from the diffuser to be between 10 and 15 feet per second which will provide ample mixing.

The volume of the pond will be sufficient to contain approximately 30 hours of discharge flow in addition to normal contents of the pond. By closing the discharge valve at the river, an accidental spill which had entered the discharge system could be contained in the pond until recovered or treated. In addition, if the reservoir conditions were unfavorable, discharge could be shut off until the

conditions improved. The pond would allow normal blowdown from the cooling towers to continue for approximately 30 hours without discharging to the reservoir. Also, blowdown from the towers could be shut off for up to an additional 30 hours.

When reservoir conditions dictate, holding up discharges in the pond, reducing tower blowdown, or combinations of both could be utilized to allow the plant to meet the applicable guidelines.

The discharge system will be constructed such that during periods when the reservoir is at its normal minimum level, navigational clearance in the reservoir will be maintained. An overflow grass-lined ditch will extend from the pond to the river to provide a flow path in the event that the diffuser pipe becomes blocked. Dimensions of the diffuser length and diameter and port size and configuration will be determined when final design is completed.

3.4.4 Essential Service Water System - The Essential Service Water (ESW) system will provide cooling water to essential plant auxiliary equipment under normal and accident conditions. The system operates on a closed cycle with waste heat being dissipated via spray ponds. Two spray ponds will be provided for each two-unit plant. Each pond will occupy between 3.5 and 4.0 acres. Spray pond arrangement and location onsite are depicted in figure 3.1-7.

The makeup and blowdown requirements for the system will be small as compared with the requirements of the CCW system. Under normal operation conditions, the makeup and blowdown requirements for the system will be approximately 1,000 and 500 gal/min/plant, respectively.

The spray ponds will serve as the ultimate heat sink for the facility. The spray ponds will be seismically qualified and will have adequate storage to maintain safe shutdown of the plant with one unit in normal shutdown and one unit in post-accident shutdown for 30 days without requiring makeup water.

REFERENCES FOR SECTION 3.4

1. Cooling Tower Drift - Its Measurement, Control and Environmental Effects: G. K. Wistrom and J. C. Ovard, paper presented at Cooling Tower Institute Annual Meeting, January 29-31, 1973.

2. Drift Technology for Cooling Towers, J. D. Holmberg and O. L. Kinney, report published by the Marley Company, 1973.

3. Managing Waste Heat with the Water Cooling Tower, J. B. Dickey, Jr., and R. E. Cates, report published by the Marley Company, 1973.

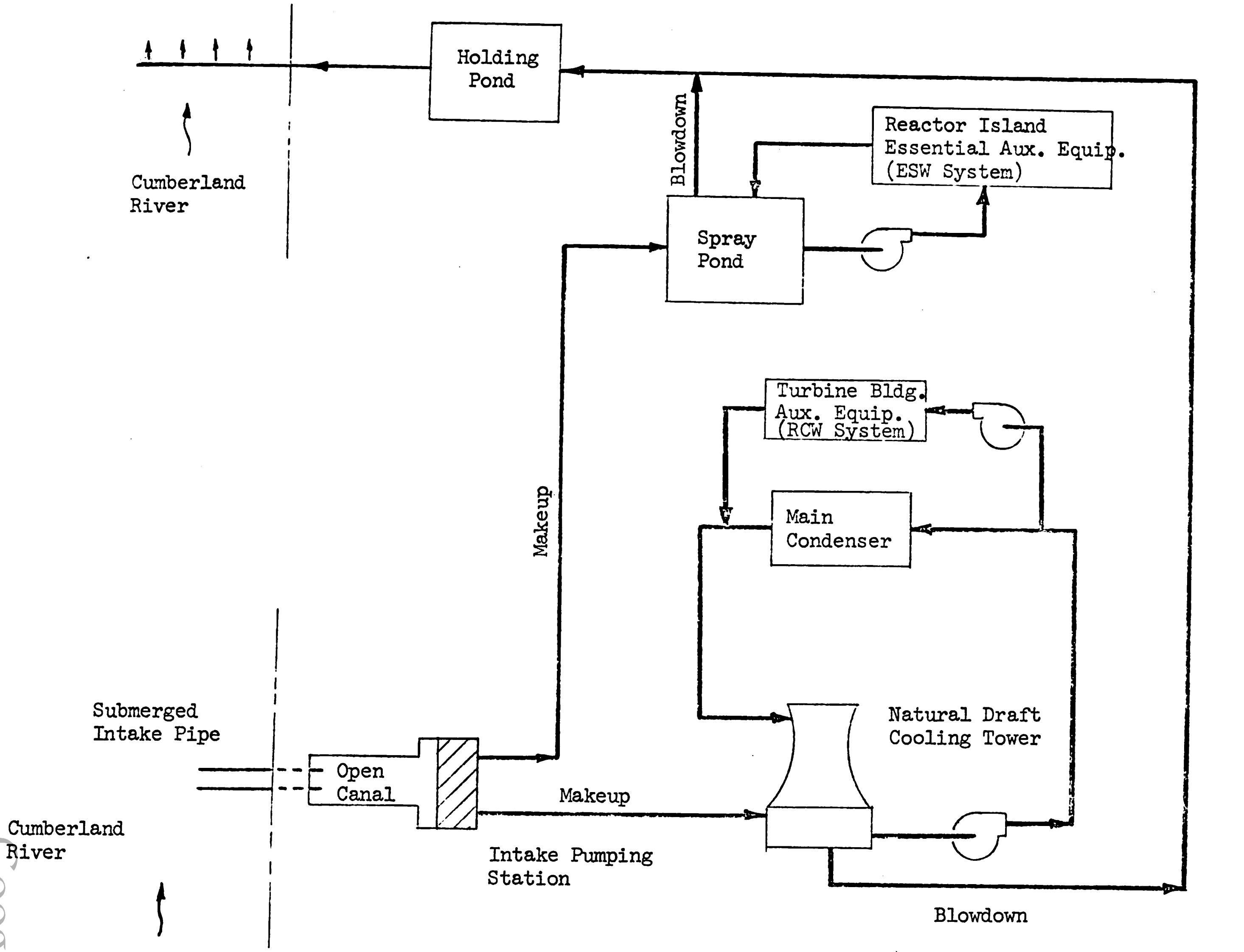


Figure 3.4-1
HARTSVILLE NUCLEAR PLANT
Heat Dissipation Diagram

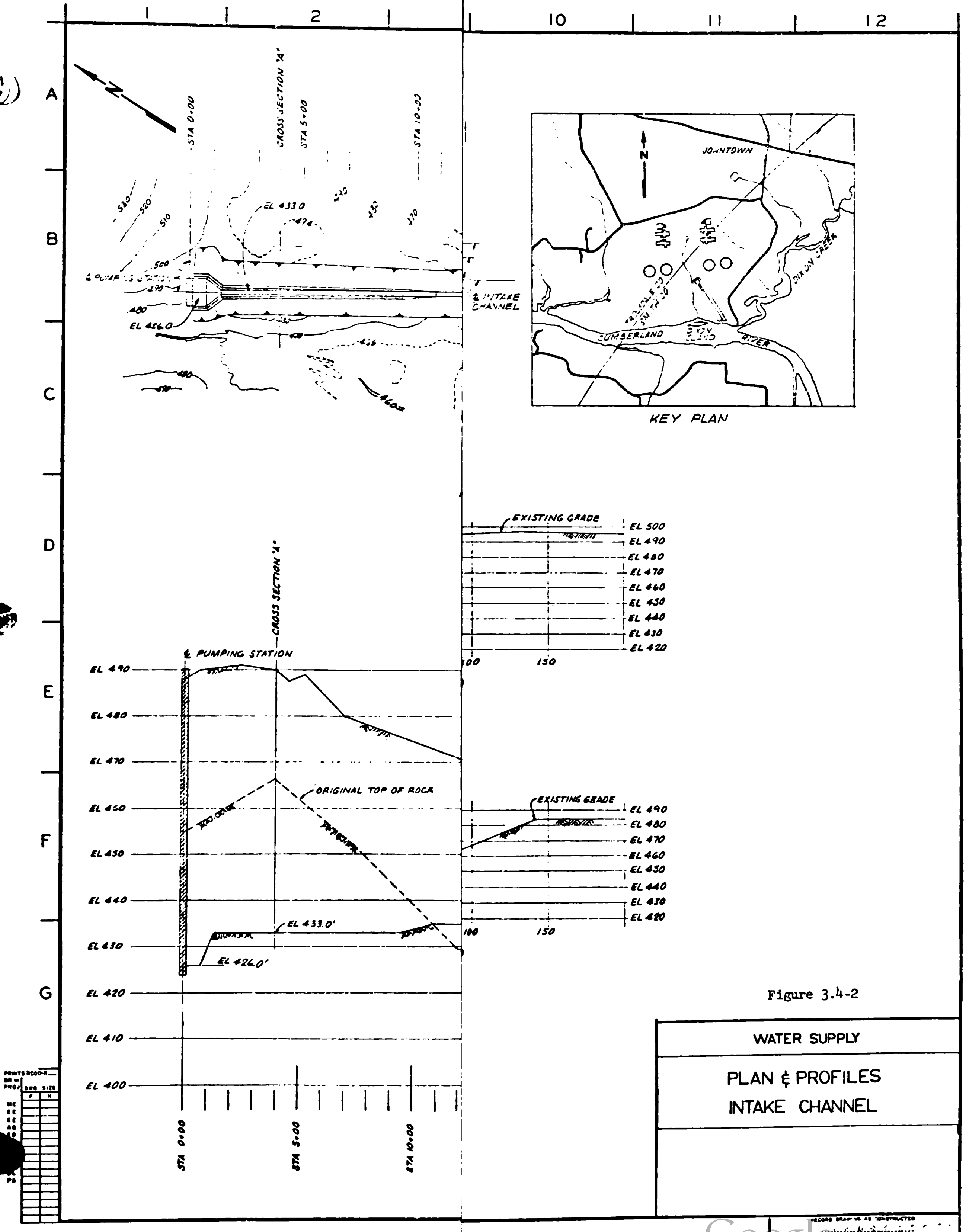


Figure 3.4-2

WATER SUPPLY

PLAN & PROFILES
INTAKE CHANNEL

3.5 3.6 3.7 3.8 3.9

3.5 Radwaste System

Each 2-unit plant will be equipped with radwaste process equipment necessary to collect, treat, and dispose of radioactive solids, liquids, and gaseous waste produced during plant operations. System descriptions, process information, and effluent release data for the solid, liquid, and gaseous radwaste systems are presented in Sections 3.5.1 through 3.5.3 below. Discussion of source terms and calculational methods is found in Section 3.5.4.

3.5.1 Liquid Radwaste System

3.5.1.1 System Description - The liquid radwaste system is designed to collect, process, recycle, and dispose of radioactive liquid wastes. The systems to be installed will limit releases to the environment to levels well below regulatory limits. This is accomplished by utilizing recycle of treated liquid waste for inplant service to the maximum extent practicable. There will be one complete liquid radwaste system per plant; that is, for a particular plant liquid radwaste will be received from each unit, but will be processed by equipment common to both units.

The liquid radwaste system consists of three subsystems: waste collector (low conductivity), floor drain - neutralizer (high conductivity), and detergent. A process flow diagram of the liquid radwaste system which shows the three subsystems is given in Figure 3.5-1. Liquid radwaste system process information such as process frequency, gross activity, conductivity, and system service data is given in Table 3.5-1. The process information in Table 3.5-1 is keyed to nodal numbers for the various components and operations depicted schematically

in Figure 3.5-1. The flow and activity data in Table 3.5-1 are on a per-unit basis. A listing of liquid radwaste process equipment is given in Table 3.5-2. System descriptions, including discussions of radioactivity released, for the Liquid Radwaste Subsystems are given below. Concentrations of radionuclides in the plant effluent prior to and after mixing in the Cumberland River are given in Table 5.2-1.

<u>3.5.1.1.1 - Waste Collector Subsystem</u> - The waste collector subsystem processes liquid waste having a relatively high purity. Typical wastes processed by this system are:

1. Equipment drains - located in the containment, auxiliary, fuel, radwaste, and turbine buildings and drywell
2. Condensate demineralizer regeneration flushes
3. Ultrasonic resin cleaner backwashes
4. Waste from filter/demineralizer operation in both the fuel pool cleanup and reactor water cleanup systems

The wastes from each of these sources are collected and then processed on a batch basis through a precoat-type traveling belt filter. Insoluble material is removed by the filter media and is routed to the solid radwaste system for solidification and packaging for disposal. The filtrate is drained to the filtrate tank, from which it is pumped through two demineralizers in series for the removal of dissolved material. After demineralization the liquid is normally returned to the condensate storage system. Under normal operating conditions, no liquids are released from the waste collector subsystem to the environment. Both normal and maximum process frequencies, flow rates, and activities for the waste collector subsystem are given Table 3.5-1.

<u>3.5.1.1.2 Floor Drain Neutralizer Subsystem</u> - The floor drain neutralizer subsystem provides a dual function. It is designed to collect and process both floor drain wastes and chemical solutions. Floor drain wastes are collected in sumps in the following locations.

1. Drywell
2. Containment building
3. Fuel building
4. Auxiliary building
5. Radwaste building
6. Turbine building

These wastes are pumped to the high-conductivity tanks to await processing. Chemical waste liquids such as decontaminants, condensate demineralizer spent regenerants, and chemical drains are also routed to the high-conductivity tanks. Before the floor drain and chemical waste collected in the high-conductivity tanks are processed, chemicals are added to give a basic pH to the entire waste solution. Wastes are processed on a batch basis. Table 3.5-1 provides process information for the floor drain neutralizer subsystem. The process is initiated by pumping the waste from the high-conductivity tanks to waste evaporators. Evaporator distillate is directed to distillate tanks. Evaporator bottoms are pumped to the concentrated waste tank for processing in the solid radwaste system. Evaporator distillate is pumped from the distillate tank through a set of demineralizers. Methods are provided to recycle the demineralizer effluent back to the high-conductivity tank should additional processing be required. During normal

plant operations, demineralized distillate will be recycled to the condensate storage system.

Water in excess of the storage capacity of the condensate storage system is routed to the excess water tank. Water in the excess water tank is then directed to the condensate storage system as capacity becomes available. Under abnormal conditions, it may be necessary to discharge excess water to the environment in order to maintain the required plant-water balance. Water to be released to the environment is sampled in the excess water tank before discharge. The water will normally be discharged to the cooling tower blowdown system but may be processed through the detergent evaporator and discharged as a vapor. The liquid effluent released to the blowdown system is discharged to the Cumberland River via a deepwater diffuser. The diffuser location is shown in Figure 3.1-7. With 4 units operating, a full blowdown flow of 50,000 gpm is available for dilution of the liquid radwastes from plants A and B. Liquid radwastes will not be discharged to the discharge pond but will be piped separately from the plants and interconnected with the discharge piping below the outlet of the discharge pond. All effluents discharged as vapor are mixed with the radwaste building exhaust air and released from the radwaste building vent. The location of the vent point is shown in Figure 3.1-8. The elevation of the release point is approximately 62 feet above finished grade. A description of the size and location of the radwaste building release point is provided in subsection 3.5.2.2

An annual release rate per nuclide per unit based on an assumed discharge of 15 percent of the floor drain neutralizer subsystem processed volume is given in Table 3.5-3. With this assumed discharge, the total annual discharge from the subsystem is

approximately 0.02 curies per year per unit, which is well below regulatory limits.

3.5.1.1.3 Detergent Subsystem - The detergent subsystem collects and treats laundry detergent wastes and laboratory washwater. Wastes discharged through the system are collected in the waste detergent tanks. Process information such as gross activity, flow rate, and process frequencies for the inputs to the detergent system are given in Table 3.5-1. From the detergent waste tanks, wastes are filtered and discharged to the detergent evaporator. Vapor from the evaporator is discharged to the atmosphere. The vapor is released to the environment along with the radwaste building ventilation air as discussed in subsection 3.5.1.1.2 above. Because release from this subsystem is a gaseous effluent, it is discussed in section 3.5.2.

3.5.2 Gaseous Radwaste System - Plant gaseous radwaste effluents are collected and processed in such a manner that their releases to the environment are as low as practicable. There are five distinct systems involving gaseous radwaste minimization and control. These systems are:

1. Condenser mechanical vacuum pump system
2. Condenser offgas system
3. Building ventilation systems
4. Separate steam-sealing system
5. Detergent waste system

Each unit will be equipped with these systems. Detailed discussions including system descriptions, release point location, and activity released for each of the above systems are presented below.

3.5.2.1 - Condenser Mechanical Vacuum Pump System - The condenser mechanical vacuum pump system is not strictly considered as a gaseous radwaste system; however, under certain operating conditions the system does exhaust radioactive gases to the environment.

The condenser mechanical vacuum pump is used to draw down the pressure in the main condenser during startup conditions. During pressure drawdown, quantities of noncondensible gases which have accumulated during shutdown and startup are expelled. When the pressure is reduced to the proper level by the vacuum pump, operation of the steam jet air ejectors is commenced, and noncondensible gases are routed to the condenser offgas system for treatment. The estimated radioactivity released to the environment via the mechanical vacuum pump route is given in Table 3.5-5. These releases are based on operation of the condenser mechanical vacuum pump 16 hours per year. Vacuum pump effluents are discharged to the environment through the turbine building vent (see subsection 3.5.2.2 for vent size, location, and so forth).

3.5.2.2 Building Ventilation Systems - The building ventilation systems are designed to:

1. Provide cooling of process equipment
2. Provide ventilation and cooling necessary for personnel safety and comfort
3. Collect, process, and exhaust airborne radioactivity.

Routine releases of radioactivity from principal buildings will be kept as low as practicable. Gaseous radioactive wastes may

be released to the environment by the following building ventilation systems:

1. Reactor building (includes drywell, containment, and annulus systems)
2. Fuel and auxiliary building
3. Turbine building
4. Radwaste building.

During normal operating conditions, gaseous releases from the fuel and auxiliary building are expected to be negligible. System descriptions and release information are given below for the reactor, turbine, and radwaste building ventilation systems.

<u>3.5.2.2.1 Reactor Building Ventilation Systems</u> - Sources of gaseous radioactive emissions from the reactor building are the drywell purge, containment purge, and annulus exhaust. Expected annual routine release from the reactor building are given in Table 3.5-5. Under normal operating conditions, each of these exhausts is vented to the atmosphere through the reactor building vent. The location of the reactor building vent is shown in Figure 3.1-8. Information on the reactor building vent size, elevation, and effluent characteristics is given in Table 3.5-6.

<u>3.5.2.2.1.1 Drywell Purge System</u> - The drywell purge is designed to reduce the levels of airborne activity in the drywell to acceptable levels in order to permit access to the drywell during hot standby, shutdown, and refueling operations. The system is designed to give one air change per hour. Purge exhausts will be continuously

monitored for activity. During purging operations, the system will vent to the atmosphere via the reactor building vent if no significant levels of activity exist. If significant activity is present, the purge exhausts will be directed to the standby gas treatment system for processing prior to release.

<u>3.5.2.2.1.2 Containment Purge System</u> - The containment purge is designed to reduce the levels of airborne activity in the containment building to acceptable levels in order to facilitate periodic access to the building. The system is designed to exhaust air at the rate necessary to maintain a slightly reduced pressure within the containment. The purge exhausts will be continuously monitored for activity. If no significant activity is present, the exhausts are vented to atmosphere through the reactor building vent. In the event of high activity, the exhausts are routed to the standby gas treatment system for processing prior to release through the reactor building vent.

<u>3.5.2.2.1.3 Annulus Exhaust and Recirculating System</u> - The annulus exhaust and recirculating system is designed to maintain a negative pressure in the annulus under normal and accident conditions. Under normal operating conditions there will be no release of activity to the environment via annulus exhausts. During normal operations annulus exhaust will be routed directly to the reactor building vent. However, during accident conditions, such as a loss of coolant accident, the exhaust may contain radioactivity. Under these conditions, annulus exhaust will be directed to the standby gas treatment system for processing and then will be released through the reactor building vent.

3.5.2.2.2 Turbine Building Ventilation System - Sources which may contribute to airborne radioactivity in the turbine building are main steam leakage, water leakage from equipment, and gaseous releases from vents and drains. Radioactive gases are collected and disposed of by the turbine building ventilation system.

The turbine building ventilation system is designed to give one air change per hour. The system employs recycle air from noncontaminated portions of the building. Makeup air is brought into the system and directed to air-handling units where the flow is split, and the separate air streams are routed to radioactivity-contaminated and noncontaminated portions of the building. Air directed to the non-contaminated areas absorbs heat from equipment and is recycled to the air-handling units where excess heat is removed. The recycled air is then mixed with outside "makeup" air. Air supplied to the contaminated areas is not recycled. The exhaust system creates a negative pressure within the contaminated areas which induces air flow from cleaner areas to contaminated areas. Air from contaminated areas is collected in a system of ducts and is discharged to the atmosphere via the turbine building vent. Effluents released will be continuously monitored for radioactivity. Upon detection of high levels of activity, the building will be isolated. The turbine building vent point location is shown in Figure 3.1-8. Information on the release point elevation, size, and effluent characteristics is given in Table 3.5-6. Expected annual routine releases from the turbine building with credit for sealing pressurized turbine building steam and flashing liquid valves 2½" and larger are given in Table 3.5-5.

3.5.2.2.3 Radwaste Building Ventilation System - Airborne activity is released to the radwaste building atmosphere by equipment leakage and gaseous releases from vents and drains. These wastes are collected and discharged to the environment by the radwaste building ventilation system. The ventilation system will be the once-through type with air flow control from areas of low-potential radioactivity to higher activity areas. All building ventilation exhausts will be monitored for radioactivity prior to discharge. On detection of high levels of radiation, air flow will be interrupted and the building will be isolated. Expected yearly routine releases from the radwaste building are given in Table 3.5-5.

The location of the radwaste building vent point is shown in Figure 3.1-8. Information on vent size and elevation and effluent characteristics is given in Table 3.5-6.

3.5.2.3 Separate Steam Sealing System - Two major sources of radioactivity release resulting from operation of the turbine cycle include : (1) exhausting of noncondensible gases originating from turbine gland sealing operations; and (2) steam leakage from turbine building pressurized steam and flashing liquid valves. The noncondensible gaseous effluents from turbine gland sealing operations are cleaned up considerably by using clean steam generated by evaporating essentially nonradioactive condensate instead of extract (nuclear) steam for turbine gland sealing. Main steam leakage

from valves to the turbine building atmosphere is mitigated by collection and containing the actual leakage itself. However, the collection and containment must be done in such a manner that air is prevented from leaking into the cycle. TVA proposes to accomplish this by equipping certain valves with multiple seals and supplying clean steam as a sealant.

<u>3.5.2.3.1 System Description</u> - A separate "clean" steam sealing system is proposed for sealing the turbine glands and all pressurized steam and flashing liquid valves located in the turbine building that are 2-1/2 inches and larger. A process diagram of the separate steam-sealing system is shown in Figure 3.5-2. The sealant steam used in the process is produced in an evaporator which is heated by extraction steam from the turbine heat cycle. The evaporator makeup is demineralized condensate. The condensate has relatively low radioactivity levels since it has been degased in the condenser, delayed in the hotwell, and demineralized. Consequently, the steam produced from the condensate is considered "clean" steam. Steam produced in the evaporator is distributed to the turbine glands and valve seals. A discussion of the steam-sealing process for the turbine glands and valve seals is given below.

<u>Turbine Glands</u> - "Clean" sealing steam is provided to both the high-pressure and low-pressure turbine glands. The purpose of steam sealing the glands is to prevent air leakage into and steam leakage from the turbine cycle. The process is initiated by directing steam from the evaporator to the turbine glands (see Figure 3.5-2). Sealing steam and inleakage air are withdrawn from the outermost turbine glands and routed to the gland steam condenser. Steam is then condensed

and the noncondensible gases are removed by the steam-packing exhauster (SPE). The effluent from the SPE is released into the environment through the turbine building vent. See Table 3.5-6 for information on the turbine building vent point location and configuration. The expected gross annual SPE releases on a per-unit basis are given in table 3.5-5.

Valve Sealing - Steam sealing is provided to the stems of the main control valves, stop valves, bypass control valves, and combined intercept valves, and all other turbine building pressurized steam and flashing liquid valves 2-1/2 inches and larger. As currently proposed, compartmentalized, multiple seals will be used on the valves. Sealing steam will enter the outermost seal chamber. The inlet steam pressure at that location will be slightly greater than atmospheric pressure and in excess of the pressure being maintained in the adjacent compartment which is connected to the main condenser or a low-pressure extraction. With these pressure conditions, if leaking occurs, clean sealing steam leaks outward to atmosphere, thereby preventing air from leaking into the cycle. The sealant steam also leaks toward the subatmospheric pressure compartment where it is drawn to the condenser (or a low-pressure heater) along with leaking main steam. By returning the main steam leakage inside the system pressure boundary, the radioactive products are effectively retained in the system whereby they will subsequently be collected and treated. It is estimated that, by the use of a sealing system, main steam leakage to the turbine building is reduced from approximately 1,500 lb/h to 340 lb/h. The reduced leakage provides a significant reduction in the annual routine release of radioactivity in

the turbine building ventilation air. The estimated routine releases from turbine building ventilation air (on a unit basis) with credit for valve sealing are given in Table 3.5-5.

3.5.2.4 Condenser Offgas System - The condenser offgas system removes noncondensible gases from the main condenser. In addition to its power generation functions, the system serves two purposes, specifically, elimination of radiolytic gases (hydrogen and oxygen) and reduction of radioactive releases to the environment. A schematic diagram of this system is presented in Figure 3.5-3.

3.5.2.4.1 System Description - Noncondensible gases are removed from the condenser by the steam jet air ejectors. Gases removed are diluted with steam to ensure that the amount of hydrogen present is less than the combustible limit, that is, 4 percent by volume. Next, the effluent is passed through a preheater where the temperature is increased to near 350° F. From the preheater the flow is routed to the recombiner. After recombination, the recombined gases and diluent steam are then condensed in the offgas condenser and carry-over moisture is removed using a water separator. The remaining noncondensible gaseous effluent, which is near 130° F., is directed to a 10-minute holdup pipe. From the holdup pipe, the gases are cooled to below 50° F. in a glycol cooler. The chilled gases are passed through a dessicant dryer for removal of essentially all moisture. The dried gases are further cooled and introduced into charcoal adsorbers. There are 12 charcoal adsorbers (3 tons each) in the system. Eight beds will be in normal service with 4 in standby. The system will be capable of

operating 12 beds during periods of high releases. The charcoal adsorbers are maintained in a refrigeration vault with an operating temperature of near 0° F. Essentially all radioproducts are removed by the charcoal beds (or decay away before leaving the beds) except the noble gases. The holdup time of noble gases on the charcoal beds is dependent on the air leakage rate into the condenser. Table 3.5-7 shows typical holdup times for xenon and krypton in an 8-charcoal bed system for various condenser air leakage rates. The gaseous effluents leaving the beds are passed through HEPA filters before reaching the environment. The gaseous effluents are released along with the turbine building ventilation exhaust. Refer to Section 3.5.2.2.2 for information on the release point location, elevation, size, and shape. Expected annual average routine releases from this system are given in Table 3.5-5. These releases are based on a condenser air inleakage rate of 20 scfm.

3.5.2.5 Detergent Waste System - As described in Section 3.5.1.1.3, detergent wastes are vaporized and discharged to the atmosphere as a gaseous effluent. The expected annual discharge of airborn effluents from the detergent subsystem of each reactor unit is given in Table 3.5-4.

3.5.3 Solid Radwaste System - The solid radwaste system is designed to collect, process, and package radioactive solid waste. Collection and processing will be done in such a manner as to restrict radioactive releases to the plant and to the environment. Shielding will be provided as necessary during processing and shipping in order to meet regulatory requirements. Department of Transportation and AEC approved shipping containers will be used. Waste shipped from the site will be in solid form. No liquids or slurries are anticipated to be shipped from the site. A system description and solid radwaste process information are presented below.

The solid radwaste system is located in the radwaste building of each plant. The system receives waste from both units. Waste processed by the system consists of evaporator concentrate, cleanup filter-demineralizer sludge, spent resins, traveling belt filter sludge and contaminated compressible and noncompressible material. A process flow diagram of the system is given in figure 3.5-4.

Phase separators for cleanup filter-demineralizer sludges are provided to collect and accumulate the solids-bearing slurry inputs, to remove the excess water, and to allow for decay when necessary. Two parallel separators are used. Excess water used in the slurry transport to the phase separators is decanted to the liquid waste system.

Spent resins from deep bed demineralizers are flushed to the spent resin tank. A screened overflow allows for recovery of excess water. No decay time is designed into the tank capacity although decay is realized between batch inputs and discharges.

Upon accumulation of the resin or filter-demineralizer sludges in
the appropriate tankage, the solids are dewatered by filtering across 3.6
a traveling belt filter precoated with diatomaceous earth. The resultant filter sludges are dropped from the filter belt into a screw conveyor
which directly feeds the shipping containers. 3.7

Concentrated wastes resulting from the high conductivity and laundry subsystems are accumulated in the concentrated waste tanks. From the concentrated waste tank, these wastes are pumped directly to the shipping container.

The shipping containers are of steel construction with a volume of 170 ft^3. An empty container is positioned under the mixing and filling station to receive wastes from the screw conveyor and the concentrated

waste tank. Typically, the container will collect filter solids from the screw conveyor for a period of about 3 days. At the end of this period, concentrated waste and cement are added and mixed with the filter solids. Mixing is accomplished by a disposable mixing blade which is an integral part of the shipping container. The filling and mixing operation is suitably instrumented to ensure that the proper proportions of wastes and cement are maintained, the container is not overfilled, and that the appropriate radiation levels are not exceeded. After mixing is completed, the container is closed, moved from the mixing and filling station on a transfer car, and then moved to the storage area with an overhead bridge crane. This entire operation is done remotely from behind shield walls through the use of a closed circuit television system and viewing window.

All slurry tanks and wet-solids handling equipment are separately shielded and are automatically operated from a remote position to reduce radiation exposure to operating personnel.

Dry solid wastes such as rags and clothing are low in radioactivity, permitting manual handling. These wastes are collected in containers near their source and moved to storage facilities in the solid waste handling area where they are compacted into 55-gallon drums with a hydraulic-press baling machine.

As with the liquid radwaste system, all solids processing equipment is shielded and remotely operated so as to minimize radiation exposure to operating personnel. Also, to minimize exposure, low maintenance of the solids handling equipment was an inherent design objective in selecting the system.

The expected nuclide distributions associated with each type of solid waste and the expected rate of shipment of these wastes (on a per unit basis) are given in Table 3.5-8.

3.5.4 Supportive Information for Routine Releases - The "Basic Data for Source Term Calculations for BWR's " as requested in Appendix 1 of AEC Regulatory Guide 4.2 is presented as Appendix A of this report. Supportive information such as assumptions, discussion of computational methods, and references which were utilized in the development of routine releases from radwaste systems discussed in subsections 3.5.1, 3.5.2, and 3.5.3 are presented below.

3.5.4.1 Liquid Radwaste Releases - Radioactive liquid releases discussed in section 3.5.1 and presented in Table 3.5-1 and 3.5-3 are based on information contained in GESSAR (see Amendment 9). Detailed technical discussions and derivations of reactor coolant activities, which are necessary source terms for the determination of liquid radwaste activities are presented in section 11.1 of GESSAR.

3.5.4.2 Gaseous Radwaste Releases

3.5.4.2.1 Condenser Offgas System Releases - Condenser offgas releases provided in table 3.5-5 were derived from the source terms (T=30 minutes) given in table A-1 of Appendix A. These releases are based on: 1) an air inleakage rate of 20 scfm, 2) 2 shell condenser, 3) AEC dynamic absorption coefficients (Reference 4), and 4) 8 charcoal beds in service.

3.5.4.2.2 Building Ventilation Releases - Routine releases cited in table 3.5-5 for the reactor and radwaste buildings are based on observations at operating BWR plants (reference 1). Turbine building noble gas and I-131 releases were also based on measurements at operating BWR plants (reference 1, 2, and 3). Turbine building releases for other radioiodine species were estimated by use of the relative abundance of the radioiodine species in reactor steam.

All turbine building releases given in table 3.5-5 reflect credit for a leakage reduction as a result of the leakage reduction systems which includes measures to control valve leakage and treat sump exhausts (see subsection 3.5.2.3).

3.5.4.2.3 Steam Packing Exhauster Releases - The SPE releases given in table 3.5-5 were derived from reactor coolant activities by using procedures and assumptions contained in AEC regulatory guide 1.42 and reference 4. The method for determining the releases is as follows. Initially, condensed reactor steam activities are reduced to account for decay resulting from the 3 minute minimum holdup time in the main condenser hotwell. Next, halogen activity reduction is taken as a result of demineralization of the condensate. A portion of the demineralized condensate is routed to a reboiler where it is converted to steam for sealing purposes (see subsection 3.5.2.3), but no credit is taken for reduction in activity during this process. The only other credit taken in the calculation is the reduction of halogen activity across SPE itself.

3.5.4.2.4 Mechanical Vacuum Pump Releases - The condenser mechanical vacuum pump releases shown in table 3.5-5 were based on 16 hours of pump operation annually, and were taken from reference 5.

3.5.4.3 Solid Radwaste System Output - The expected solid waste activity data and production rates presented in table 3.5-8 are based on information in section 11.5 of GESSAR. The activity levels and production rates are dependent on liquid radwaste system activities

and process of frequencies. The liquid radwaste system activities are in turn dependent on the reactor coolant activities. Information such as reactor coolant activities and process decontamination factors which are necessary for development of solid radwaste activity estimates are found in section 11.1 and 11.2 of GESSAR respectively.

References for Section 3.5

1. Testimony of N. R. Norton before the AEC, Docket No. RM-502, November 9, 1973.

2. C. A. Pelletier, "Results of Independent Measurements at Boiling Water Reactors," DRO-AEC, May, 1973

3. "Results of Measurements of Iodine - 131 in Air, Vegetation, and Milk at Three Operating Reactor Sites," DOR-AEC, October, 1973.

4. Final Environmental Statement Concerning Proposed Rule Making Action: Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As low as Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents, Directorate of Regulatory Standards U.S. Atomic Energy Commission Issued July 1973, WASH-1258.

5. Principle Parameters Used in BWR Source Term Calculations - AEC Draft dated February 20, 1973.

Table [illegible]-1

LIQUID RADWASTE PROCESS INFORMATION (PER UNIT BASIS)

[illegible]

STREAM NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
NORMAL BATCH/DAY	0.5/1	4/1	1.1/1	0.3/1	1/80	1/68		1/1	13/80	1/1	6/1	8/1	8/1	—	13/80	—	1.5/1	2.2/1	1.1/1	2.2/1	1/1	—
MAXIMUM BATCH/DAY	64/1	16/1	1.1/1	0.3/1	1/60	1/1		4/1	4/1	3/1	10/1	10/1	10/1	—	4/1	—	64/1	17/1	1.1/1	2.2/1	—	—
NOR DAILY VOL, GAL/DAY	3850	3750	1000	5725	—	—		15,000	—	30,000	30,000	10,000	10,000	38,825	—	500	700	2000	900	2000	500	—
MAX DAILY VOL, GAL/DAY	28,800	14,400	1000	5725	—	4200		60,000	78,000	88,000	88,000	88,000	88,000	40,000	48,000	500	28,800	5,000	900	2000	—	—
BATCH VOL, GAL/BATCH	450	900	900	500	1900	4200		15,000	17,000	10,000	5000	5000	5000	—	12,000	—	450	900	900	900	500	—
BATCH WT, LB/BATCH	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
DRY SOLIDS WT, LB/BATCH	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
DRY SOLIDS WT %	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
DRY SETTLED SOLIDS DEN., LB/FT	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
NORMAL LIQ ACT CONC, μCi/cc	5E-2	1E-2	7E-5	2E-5	—	2E-2	-	3E-2	1E-2	2E-2	1E-2	1E-2	5E-4	—	2E-2	3E-6	7E-6	1E-8	1E-5	7E-7	2E-2	—
MAXIMUM LIQ ACT CONC, μCi/cc	1.00	[illegible]	2E-3	1E-2		5E-1		3E-2	1E-2	2E-1	2E-1	2E-1	2E-3		6E-1	2E-4	7E-2	1E-3	4E-4	2E-5	—	—
NORMAL DAILY LIQ ACT, μCi/DAY	7E05	2E05	3E02	4E02	—	-		1E06	—	2E06	1E06	1E06	2E04	2E04	—	8E00	2E01	8E00	5E01	5E00	3E04	—
MAXIMUM DAILY LIQ ACT, μCi/DAY	2E07	5E06	7E03	3E05	--	1E06		1E06	--	3E07	3E07	3E07	3E05	3E05	1E07	4E02	2E05	8E03	1E03	1E02	—	—
NORMAL SOLID ACT, μCi/BATCH	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MAXIMUM SOLID ACT, μCi/BATCH	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
FLOW, GPM	50	100	50	50	120	50		50	180	120	120	350	350	350	180	—	50	150	50	50	50	25
UNDISSOLVED SOLIDS, PPM	2	2	2	2	>1	10		125	80	30	1	1	<1	<1	80	—					—	—
CONDUCTIVITY, UMHO/CM					—			—	—	30	30			<1	30,000	—						—

STREAM NO.	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
NORMAL BATCH/DAY	--	--	1	--	1/6		6/1	1/1	1/10		1/300	1/10	—	—	—	—		1/16	1/16	1/17	1/16	1/18
MAXIMUM BATCH/DAY	--	--	1/1	--	1/6		18/1	3/1	1/60		1/1	1/10	—	--	—	--		4/1	4/1	1/1	4/1	4/1
NOR DAILY VOL, GAL/DAY	1600	100	1100	1050	50		660	35	—		—	—	—	—	—	—		9000	8825	175	8825	8825
MAX DAILY VOL, GAL/DAY	1000	100	1100	1050	50		2000	100	—		8400	--	—	—	—	—		55,000	52,000	3000	52,000	52,000
BATCH VOL, GAL/BATCH		—	1100	1050	300		110	35	900		8400	4300	-	—	—	—		14,000	13,800	3000	13,800	13,800
BATCH WT, LB/BATCH	--	—	—	—			800	300	17,000		72,000	36,000	—	—	—	—		—	—	—	—	—
DRY SOLIDS WT, LB/BATCH	—	--	—	—	—		8	15	1350		8600	130	—	—	—	—		—	—	—	—	--
DRY SOLIDS WT %	—	—	—	--	25		1	5	8		11	0.3	--	—	—	—		—	—	25	—	—
DRY SETTLED SOLIDS DEN., LB/FT	—	—	—	—	—		8	8	9		24	13	—	--	—	—		—	—	—	—	—
NORMAL LIQ ACT CONC, μCi/cc	1E-5	1E-5	1E-5	—	3E-3		—	—	2E-2		—	7E-6	—	—	—	—		5E-3	5E-6	3E-1	5E-8	5E-7
MAXIMUM LIQ ACT CONC, μCi/cc	1E-5	1E-5	1E-4	—	3E-2		—	—	5E-1		—	3E-4	—	—	—	—		3E-1	3E-4	1.5E01	3E-4	3E-5
NORMAL DAILY LIQ ACT, μCi/DAY	3E01	4E00	3E01	3E-1	1E02		—	—	--		—	—	—	—	—	—		2E05	2E03	2E05	2E03	2E02
MAXIMUM DAILY LIQ ACT, μCi/DAY	3E01	4E00	1E03	1E01	1E03		—	--	-		—	—	—	—	—	—		1E07	1E04	1E07	1E04	1E03
NORMAL SOLID ACT, μCi/BATCH	--	—	--	--	—		—	---	1E08		6E06	3E04	—	--	—	—		—	—	—	—	—
MAXIMUM SOLID ACT, μCi/BATCH	—	—	—	—	—		—	—	3E08		3E07	3E06	—	—	—	—		—	—	—	—	—
FLOW, GPM	—	—	5	5	—		450		120		120	120	400	400	200	200		40	40	--	150	150
UNDISSOLVED SOLIDS, PPM	—	—	—	—	—		—	—	—		—	3000	—	—	—	—		65	1	—	1	<1
CONDUCTIVITY, UMHO/CM	2000	—	2000	20	—		—	—	—		—	—	—	—	—	—		15,000	15	—	5	<1

STREAM NO.	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
NORMAL BATCH/DAY	0	0	—	—	—		1/35	1/225						1/30	1/30	2/6.6		13/1100	1/1100	1/1100	1/1100	6/1	15/40		36/100	2/350
MAXIMUM BATCH/DAY	—	—	—	—	—		—	—						—	—	2/1		1.6/1	—	—	—	18/1	15/40		36/1	2/14
NOR DAILY VOL, GAL/DAY	0	0	—	—	—		—	—						—	—	4200		3300	2100	2100	2100	—	—		—	—
MAX DAILY VOL, GAL/DAY	52,000	52,000	—	—	—		2100	2100						30	30	2100		2100	2100	2100	2100	5	75		75	21,000
BATCH VOL, GAL/BATCH	—	—	—	—	—		2100	2100						—	—	18,000		18,000	18,000	18,000	18,000	30	205		540	—
BATCH WT, LB/BATCH	—	—	—	—	—		18,000	18,000						—	—	75		4300	4300	4300	4300	11	90		240	—
DRY SOLIDS WT, LB/BATCH	—	—	—	—	—		4300	4300						—	—	0.43		23	23	23	23	44	44		44	25
DRY SOLIDS WT %	—	—	—	—	—		23	23						—	—	9		24	24	24	24	17	9		24	—
DRY SETTLED SOLIDS DEN., LB/FT	—	—	—	—	—		24	24						—	—	2E-2		7E-6	7E-6	7E-6	7E-6	—	—		—	3E-2
NORMAL LIQ ACT CONC, μCi/cc	—	—	—	—	—		7E-6	7E-6						—	—	5E-1		3E-4	3E-4	3E-4	3E-4	—	—		—	1E00
MAXIMUM LIQ ACT CONC, μCi/cc	—	—	—	—	—		3E-4	3E-4						—	—	—		—	—	—	—	—	—		—	—
NORMAL DAILY LIQ ACT, μCi/DAY	—	—	—	—	—		—	—						—	—	—		—	—	—	—	—	—		—	—
MAXIMUM DAILY LIQ ACT, μCi/DAY	1E03	1E03	—	—	—		—	—						—	—	1E08		6E06	9E06	2E04	1E05	1E05	2E07		2E05	—
NORMAL SOLID ACT, μCi/BATCH	—	—	—	—	—		9E06	2E06						—	—	2E09		3E07	6E07	2E07	1E08	1E08	5E07		8E05	—
MAXIMUM SOLID ACT, μCi/BATCH	—	—	—	—	—		8E07	2E07						—	—	50		200	200	400	200	—	—		—	300
FLOW, GPM	350	350	—	—	—		200	200						—	—	—		—	—	—	—	—	—		—	—
UNDISSOLVED SOLIDS, PPM	—	—	—	—	—		—							—	—	—		—	—	—	—	—	—		—	—
CONDUCTIVITY, UMHO/CM	—		>10	>1	>100													—	—	—	—	—	—		—	—

3.9 \ 3.8 \ 3.7 \ 3.6

Table 3.5-1 (Continued)

LIQUID RADWASTE PROCESS INFORMATION (PER UNIT BASIS)

SERVICE STREAM NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
UTILITY	WTR	WTR		WTR	WTR			COND	COND	COND				STM	STM	STM	STM		AIR	AIR
PRESSURE, PSIG	80	50		80	80			50	50	50				100	30	30	50		10	100
FLOW, LB/HR, GPM, SCFM	80	2400		20	10			30	100	200					2E04	3E03			125	—
HEAT, BTU/HR	8E05	2E07		5E05	6E04			—	—	—				3E07	2E07	3E08	6E04		—	—
TEMPERATURE, °F	90	90		90	90			—	—	—				—	—	—	—		—	—

TABLE 3.5-2

LIQUID RADWASTE SYSTEM PROCESS EQUIPMENT

Equipment Name	Size	Quantity
Low-Conductivity Tank	57,000 Gal	2
Waste Filter	54 Ft^3	2
Filtrate Tank	3,000 Gal	2
Low-Conductivity Demineralizer	180 Ft^3	1
Backup Demineralizer	180 Ft^3	1
High-Conductivity Tank	18,000 Gal	3
Waste Evaporator	40 Gal/min	2
Concentrate Waste Tank	25,000 Gal	1
Distillate Tank	3,000 Gal	1
Distillate Demineralizer	180 Ft^3	1
Cleanup Phase Separator	12,500 Gal	2
Spent Resin Tank	10,000 Gal	1
Excess Water Tank	50,000 Gal	2
Detergent Waste Tank	1,500 Gal	2
Detergent Filter	25 Gal/min	1
Detergent Evaporator	5 Gal/min	1

Table 3.5-3

EXPECTED DISCHARGE OF LIQUID
RADIOACTIVE EFFLUENTS FROM EACH REACTOR UNIT

Nuclide	Amount Released (Ci/yr)	Nuclide	Amount Released (Ci/yr)
Sr-89	2.3 E-5*	Br-83	1.3 E-4
Sr-90	1.7 E-6	Br-84	2.7 E-4
Sr-91	5.6 E-4	Br-85	1.8 E-4
Sr-92	1.0 E-3	I-131	1.1 E-4
Zr-95	3.0 E-7	I-132	1.1 E-3
Zr-97	2.5 E-7	I-133	7.4 E-4
Nb-95	3.1 E-7	I-134	2.3 E-3
Mo-99	1.7 E-4	I-135	1.1 E-3
Tc-99m	6.9 E-4		
Tc-101	1.4 E-3		
Ru-103	1.5 E-7		
Ru-106	1.9 E-8	Na-24	2 E-5
Te-129m	2.6 E-6	P-32	2 E-7
Te-132	1.1 E-4	Cr-51	5 E-6
Cs-134	1.2 E-6	Mn-54	4 E-7
Cs-136	8.0 E-7	Mn-56	5 E-4
Cs-137	1.8 E-6	Co-58	5 E-5
Cs-138	1.9 E-3	Co-60	5 E-6
Ba-139	1.5 E-3	Fe-59	8 E-7
Ba-140	6.7 E-5	Ni-65	3 E-6
Ba-141	1.8 E-3	Zn-65	2 E-8
Ba-142	1.8 E-3	Zn-69m	3 E-7
Ce-141	3.0 E-7	Ag-110m	6 E-7
Ce-143	2.7 E-7	W-187	3 E-5
Ce-144	2.6 E-7		
Pr-143	2.9 E-7		
Nd-147	1.1 E-7		
Np-239	1.9 E-3		

*2.3 E-5 = 2.3×10^{-5}

Table 3.5-4

EXPECTED DISCHARGE OF AIRBORNE EFFLUENTS
RESULTING FROM EVAPORATION OF DETERGENT WASTES
FROM EACH REACTOR UNIT

Nuclide	Amount Released (Ci/yr)	Nuclide	Amount Released (Ci/yr)
Sr-89	6.4 E-8*	Br-83	3.6 E-7
Sr-90	4.7 E-9	Br-84	7.5 E-7
Sr-91	1.6 E-6	Br-85	5.0 E-7
Sr-92	2.8 E-6	I-131	3.1 E-7
Zr-95	8.4 E-10	I-132	3.1 E-6
Zr-97	7.0 E-10	I-133	2.1 E-6
Nb-95	8.6 E-10	I-134	6.4 E-6
Mo-99	4.7 E-7	I-135	3.1 E-6
Tc-99m	1.9 E-6		
Tc-101	3.9 E-6		
Ru-103	4.2 E-10		
Ru-106	5.3 E-11	Na-24	6 E-8
Te-129m	7.2 E-9	P-32	6 E-10
Te-132	3.1 E-7	Cr-51	1 E-8
Cs-134	3.3 E-9	Mn-54	1 E-9
Cs-136	2.2 E-9	Mn-56	1 E-6
Cs-137	5.0 E-9	Co-58	1 E-7
Cs-138	5.3 E-6	Co-60	1 E-8
Ba-139	4.2 E-6	Fe-59	2 E-9
Ba-140	1.9 E-7	Ni-65	8 E-9
Ba-141	5.0 E-6	Zn-65	6 E-11
Ba-142	5.0 E-6	Zn-69m	2 E-10
Ce-141	8.4 E-10	Ag-110m	2 E-9
Ce-143	7.5 E-10	W-187	2 E-8
Ce-144	7.2 E-10		
Pr-143	8.1 E-10		
Nd-147	3.1 E-10		
Np-239	5.3 E-6		

* 6.4 E-8 = 6.4×10^{-8}

TABLE 3.5-5

ROUTINE RADIOACTIVE RELEASES IN GASEOUS EFFLUENTS
(μCi/UNIT/YR)
(Exclusive of detergent system effluents)

Isotope	Reactor Building	Radwaste Building	Turbine Building	Charcoal Bed Exhaust	SPE Offgas	Mechanical Vacuum Pump	Total μCi/Unit/Yr
Kr 85M	7.6(+ 6)*	--	1.0(+ 7)	--	--	--	1.8(+ 7)
Kr 85	--	--	--	5.0(+ 8)	--	--	5.0(+ 8)
Kr 87	5.1(+ 6)	--	1.9(+ 7)	--	--	--	2.4(+ 7)
Kr 88	1.0(+ 7)	--	4.0(+ 7)	--	--	--	5.0(+ 7)
Xe 133	2.0(+ 8)	--	5.1(+ 7)	--	--	2.3(+ 9)	2.6(+ 9)
Xe 135 m	7.6(+ 7)	--	1.1(+ 8)	--	7.1(+ 5)	--	1.9(+ 8)
Xe 135	7.6(+ 7)	--	1.0(+ 8)	--	--	3.5(+ 8)	5.3(+ 8)
Xe 138	2.5(+ 7)	--	2.0(+ 8)	--	--	--	2.3(+ 8)
I 131 E[a]	3.8(+ 3)	1.1(+ 2)	7.6(+ 3)	--	2.5(+ 3)	--	1.4(+ 4)
I 132 E	7.6(+ 4)	2.1(+ 3)	8.7(+ 4)	--	2.9(+ 4)	--	1.9(+ 5)
I 133 E	3.8(+ 4)	1.1(+ 3)	6.0(+ 4)	--	1.9(+ 4)	--	1.2(+ 5)
I 134 E	1.9(+ 5)	5.0(+ 3)	1.3(+ 4)	--	4.6(+ 4)	--	2.5(+ 5)
I 135 E	7.6(+ 4)	2.1(+ 3)	6.0(+ 4)	--	1.9(+ 4)	--	1.6(+ 5)
I 131 NE[b]	3.8(+ 3)	1.1(+ 2)	7.6(+ 3)	--	2.5(+ 3)	--	1.4(+ 4)

a. E = elemental
b. NE = non-elemental
*7.6(+6) = 7.6×10^6

TABLE 3.5-6

BUILDING VENT AND EXHAUST DATA
(On A Per-Building Basis)

Building	Radwaste	Reactor	Turbine
Expected Flowrate	17,600 ft^3/min	35,700 ft^3/min	75,000 ft^3/min
Effluent Temperature*	90°F.	90°F.	90°F.
Effluent Velocity	2,500 ft/min	2,500 ft/min	2,500 ft/min
Release Elevation (Above Sea Level)	607 ft	726 ft	670 ft
Vent Diameter	36 in	50 in	75 in

*** Normal operating maximum temperature. Dose calculations in Chapter 5 and Appendices I1 and I2 do not reflect credit for effluent plume rise resulting from increased effluent temperature.**

TABLE 3.5-7

HOLDUP TIMES FOR Xe & Kr AS A
FUNCTION OF CONDENSER AIR INLEAKAGE
8 BED CHARCOAL SYSTEM

Air Inleakage (scfm)	Holdup Time	
	Krypton	Xenon
20	70 hours	65 days
30	46 hours	42 days
40	35 hours	32 days
50	28 hours	26 days
60	23 hours	21 days

Table 3.5-8

EXPECTED SOLID WASTE RADIOACTIVITY CONTENTS AND PRODUCTION RATES (PER UNIT BASIS)

	Cleanup Sludge and Spent Resin Containers (6.4 Containers/60 Days)		Filter Sludge and Concentrated Waste Containe (1 Container/2.8 Days)	
Nuclide	Cleanup Sludge Curies/Container	Spent Resin Curies/Container	Filter Sludge Curies/Container	Concentrated Wastes Curies/Container
Na-24	8.5 E-31 *	8.5 E-05	0.	1.4 E-05
P-32	4.3 E-03	4.9 E-03	0.	1.1 E-04
Cr-51	7.5 E-01	0.	2.1 E-01	3.5 E-03
Mn-54	4.5 E-01	0.	2.0 E-02	4.0 E-04
Mn-56	0.	0.	9.9 E-02	2.3 E-10
Co-53	2.8 E+01	0.	2.3 E+00	4.4 E-02
Co-60	6.7	0.	2.6 E-01	5.2 E-03
Fe-59	2.8 E-01	0.	3.7 E-02	6.7 E-04
Ni-65	0.	0.	5.9 E-04	1.2 E-12
Zn-65	2.1 E-02	3.1 E-03	0.	2.2 E-05
Zn-69m	2.7 E-35	9.8 E-07	0.	1.5 E-07
Ag-110m	6.6 E-01	0.	3.1 E-02	6.2 E-04
W-187	1.8 E-19	0.	7.7 E-02	1.2 E-04
Br-83	0.	3.0 E-05	0.	2.5 E-10
Br-84	0.	4.7 E-07	0.	1.4 E-31
Br-85	0.	2.5 E-11	0.	0.
I-131	2.4 E-01	2.7 E+00	0.	5.8 E+00
I-132	0.	2.2 E-04	0.	9.3 E-10
I-133	1.2 E-20	4.7 E-02	0.	9.4 E-02
I-134	0.	2.2 E-05	0.	3.1 E-20
I-135	0.	4.1 E-03	0.	2.2 E-04
Sr-89	1.1 E+01	2.4 E+00	0.	2.4 E-02
Sr-90	2.8 E+00	3.6 E-01	0.	2.4 E-03
Sr-91	0.	7.4 E-04	0.	5.7 E-05
Sr-92	0.	1.8 E-05	0.	9.7 E-10

(Continued)

Table 3.5-8 (Continued)

EXPECTED SOLID WASTE RADIOACTIVITY CONTENTS AND PRODUCTION RATES (PER UNIT BASIS)

	Cleanup Sludge and Spent Resin Containers (6.4 Containers/60 Days)		Filter Sludge and Concentrated Waste Containe (1 Container/2.8 Days)	
Nuclide	Cleanup Sludge Curies/Container	Spent Resin Curies/Container	Filter Sludge Curies/Container	Concentrated Mastes Curies/Container
Zr-95	1.8 E-01	0.	1.6 E-02	3.0 E-04
Zr-97	1.9 E-29	0.	5.1 E-04	3.3 E-07
Nb-95	8.4 E-02	0.	1.5 E-02	3.1 E-04
Mo-99	2.9 E-06	1.0 E-02	1.9 E+00	1.2 E-02
Tc-99m	0.	2.0 E-04	0.	3.0 E-06
Tc-101	0.	1.8 E-10	0.	0.
Ru-103	4.9 E-02	0.	7.4 E-03	1.3 E-04
Ru-106	2.6 E-02	0.	1.2 E-03	2.3 E-05
Te-129m	3.2 E-01	0.	1.2 E-01	2.0 E-03
Te-132	2.1 E-05	0.	1.6 E+00	1.1 E-02
Cs-134	1.8 E+00	2.4 E-01	0.	1.6 E-03
Cs-136	1.3 E-02	2.0 E-02	0.	4.6 E-04
Cs-137	2.9 E+00	3.7 E-01	0.	2.5 E-03
Cs-138	0.	2.8 E-08	0.	5.9 E-31
Ba-139	0.	2.0 E-06	0.	5.8 E-15
Ba-140	1.0 E+00	1.6 E+00	0.	3.8 E-02
Ba-141	0.	1.0 E-09	0.	0.
Ba-142	0.	3.7 E-11	0.	0.
Ce-141	7.0 E-02	0.	1.4 E-02	2.6 E-04
Ce-143	3.3 E-16	0.	1.2 E-03	3.4 E-06
Ce-144	3.4 E-01	0.	1.5 E-02	3.0 E-04
Pr-143	5.8 E-03	0.	1.1 E-02	1.7 E-04
Nd-147	8.6 E-04	0.	3.9 E-03	5.2 E-05
Np-239	1.6 E-06	7.1 E-01	0.	9.2 E-02
Subtotal Curies/Container	5.7 E+01	8.5 E+00	6.8 E+00	6.1 E+00

(Continued)

Table 3.5-8 (continued)

EXPECTED SOLID WASTE RADIOACTIVITY CONTENTS AND PRODUCTION RATES (PER UNIT BASIS)

Nuclide	Cleanup Sludge and Spent Resin Containers (6.4 Containers/60 Days)		Filter Sludge and Concentrated Waste Container (1 Container/2.8 Days)	
	Cleanup Sludge	Spent Resin	Filter Sludge	Concentrated Mastes
Bone Dry Waste, Pounds/Container	210	1,230	170	6,950
Total Curies/Container	6.6 E+01		1.3 E+01	
Total Net Weight[a] Pounds/Container	12,700		15,700	

*8.5E-31 = 8.5 X 10^{-31}

a. Includes Cement

3.7 3.8 3.9

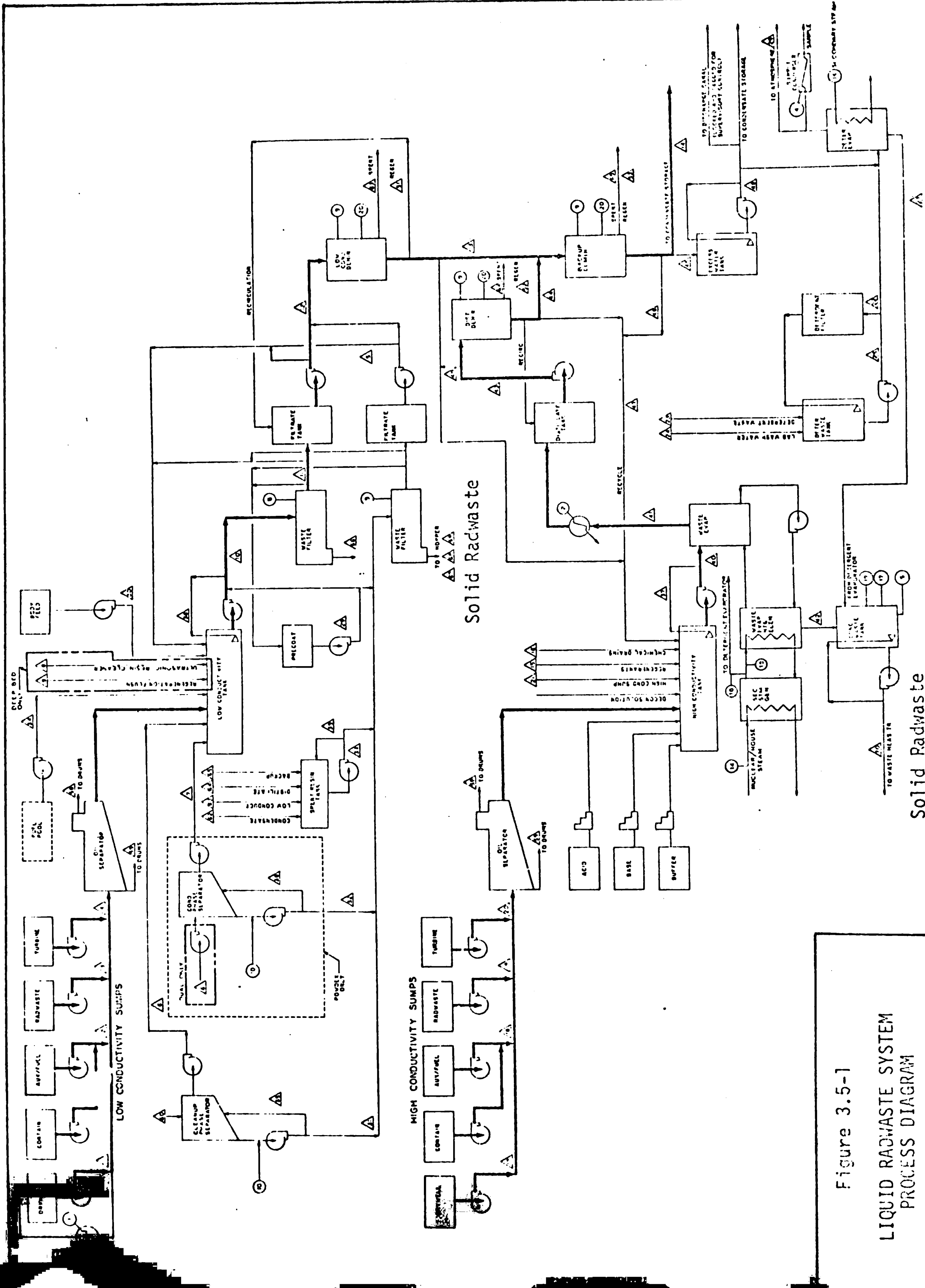


Figure 3.5-1

LIQUID RADWASTE SYSTEM PROCESS DIAGRAM

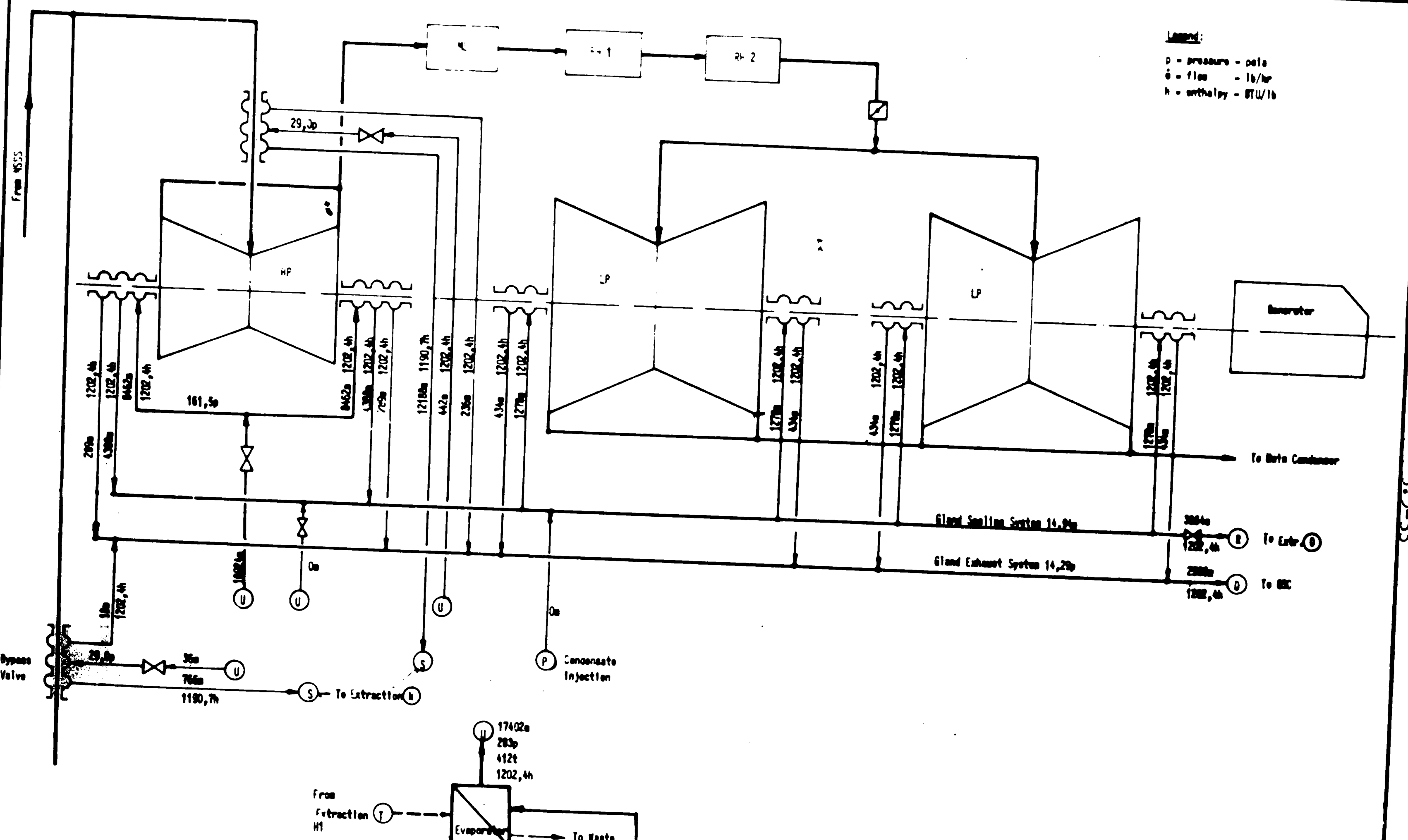


Figure 3.5-2

DISTRIBUTION OF SEALING STEAM
(EXPECTED CONDITION)

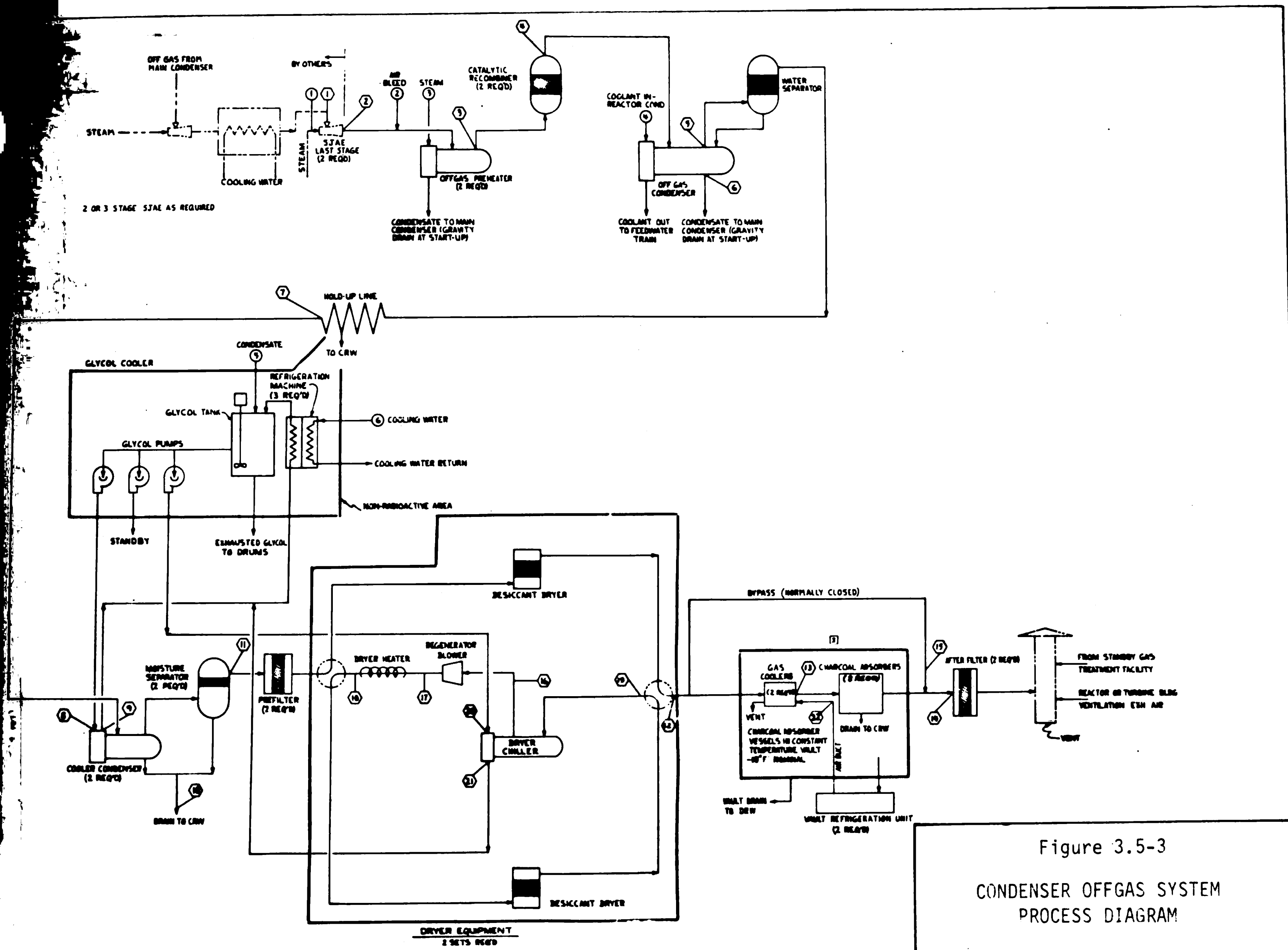


Figure 3.5-3

CONDENSER OFFGAS SYSTEM
PROCESS DIAGRAM

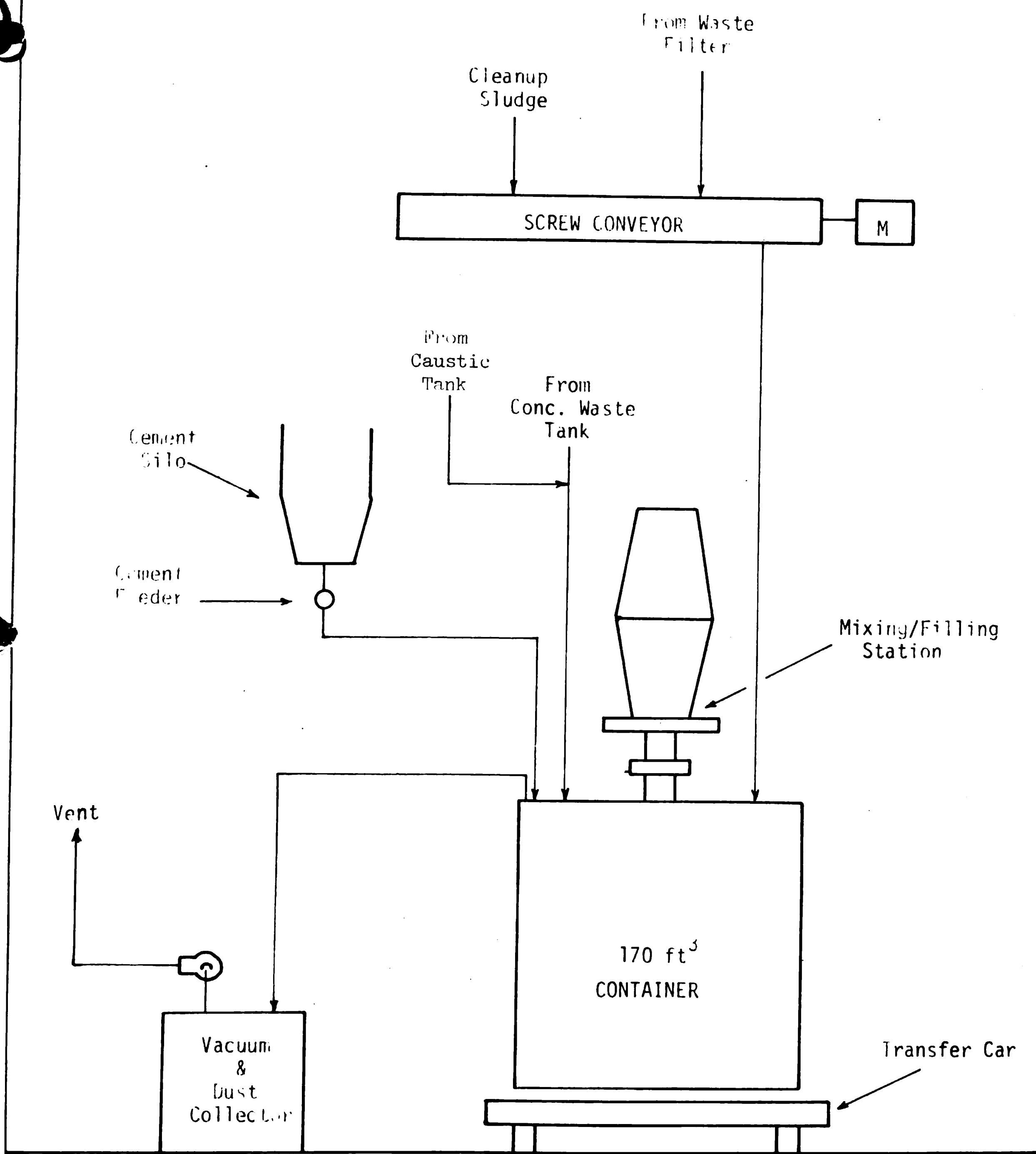


Figure 3.5-4

SOLID RADWASTE SYSTEM DIAGRAM

3.6 Nonradioactive Chemical Wastes

General - It is TVA's policy to keep the discharge of all wastes from its facilities at the lowest practicable level by using the best and highest degree of waste treatment which is available with existing technology and within reasonable economic limits.

Included in this section is a description of the potential sources of discharge of nonradioactive chemical wastes which have been identified which might go to the local environment. Also included in this section are descriptions of the treatment these potential wastes receive and the maximum and normal concentrations of these potential wastes which could be present upon discharge from the plant.

Discharges from the Hartsville Nuclear Plant will be released to the reservoir through a diffuser system. A schematic representation of the discharge system is shown in figure 3.1-7. The proposed diffuser will mix the discharge with approximately nine equal parts of reservoir water. A schematic of the chemical discharge modes is shown in figure 3.6-1.

3.6.1 Condenser Cooling Water Systems - Effluents from the condenser cooling water systems will be discharged primarily by two modes. Approximately 111 ft^3/s of water from the cooling towers would be blown down during operation of the towers to maintain a cooling system solids concentration of about twice that of the reservoir solids concentration. In addition, approximately 0.40 ft^3/s of cooling tower water will be physically entrained in the air draft through the towers and carried out of the towers. This effluent is called the "drift" from the towers.

3.6.1.1 Blowdown - Blowdown from the towers will be discharged to the reservoir through a diffuser system. A description of the diffuser system is contained in section 3.4.3. This system is designed (1) to provide good diffusion and mixing with the reservoir and (2) to minimize environmental effects due to disturbance of aquatic life during construction and operation of the plant.

As described in section 2.5.1.4, Hydrological Properties, there will occur periods of low or no flow in the reservoir past the plant site. These periods will be relatively short in duration, but during these periods, there may be insufficient flow to provide dilution sufficient to meet applicable water quality standards. During these periods, discharge from the plant can be held up or reduced to meet these standards until adequate flows in the reservoir have resumed. As discussed in section 3.4.3, there is capacity within the discharge system to allow the blowdown from the towers to continue for up to 30 hours but to hold up discharge by storing it in the discharge pond and not releasing it to the reservoir. Using this capacity, blowdown could continue from the towers after the discharge to the reservoir had been held up until the pond was filled. After this time, blowdown would be shut off and the concentration of solids in the cooling system would build up. As soon as adequate flow in the reservoir resumed, the normal blowdown from the towers of approximately 111 ft^3/s would be reinstated, and the solids concentration factor would gradually reduce to the original operating level of twice the reservoir concentration. The accumulated blowdown in the pond would be gradually discharged until the pond level was reduced to the normal operating level in readiness of subsequent periods when holdup would be required. This

type of operation will tend to reduce the average concentration of solids discharged to the river.

If the pond holdup scheme were not employed and blowdown were cut off during these low flow periods, even under the most severe conditions (i.e., maximum evaporation rate, full load operation, and extended periods of low flow cyclic-type operation) the concentration factor[a] would not exceed 6.6. Even this factor would be seen only for very short periods. The average concentration factor during these short periods would be less than 5.0. The expected effluent concentrations for the maximum expected concentration factor of 6.6 is shown in table 3.6-1, along with the applicable standards and guidelines. Water quality data for the Cumberland River is shown in table 3.6-1.

<u>3.6.1.2 Drift</u> - Discharge from the cooling towers through drift is expected to be less than 0.40 ft^3/s (based on design drift loss of 0.01 percent). This amount of drift will result in a discharge of approximately 484 lbs/d of solids when operating at full load. Most of the drift will fall in the immediate vicinity of the towers and essentially all of the drift falls within 2,000 feet of the towers.[1,2]

<u>3.6.1.3 Chemical Additives to Systems</u> - The water in the Old Hickory Reservoir is of a scaling nature so the use of corrosion inhibitors will not be necessary. An automatic mechanical system will be used to clean the condenser tubes so no chemical cleaning of the

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[a] $\text{Concentration factor} = \dfrac{\text{Concentration in Discharge}}{\text{Concentration in River}}$

condenser circulating system should be necessary. It is anticipated, however, that a biological control method may have to be used at the plant to control growth of fauna or flora in the CCW and RCW systems. The method proposed is to inject chlorine in the form of sodium hypochlorite. The hypochlorite would be injected into the CCW and RCW systems to achieve a residual of 0.5 ppm for one hour daily. During this period of time, it is expected that the blowdown from the cooling towers will be shut off to avoid a discharge of chlorine to the receiving stream. After completion of the chlorination period, the blowdown would remain closed a sufficient time to assure that the chlorine demand of the system depletes most of the chlorine residual. After sufficient time to assure that residual chlorine is within acceptable limits, blowdown will be resumed.

Further concentration reduction will occur when the blowdown is mixed with the reservoir water at a dilution factor of 10.

There exists a possibility that problems with fouling may develop in components of smaller cooling water systems such as the ESW and RCW systems due to the invasion species, corbicula manilensis, the Asiatic clam. Experience at operating plants indicates a maximum problem period of about 120 days during spring and fall when the verliger larvae are in the water. If a problem develops, the chlorine biocide feed discussed above may not be adequate to deal effectively with these clams. Acrolein, an unsaturated aldehyde proven to be very effective in the control of Asiatic clams, would probably be fed to the smaller raw cooling water systems.

Acrolein would not be fed directly to the condenser circulating water since the larger tubing of the condenser is expected to be adequately cleaned by the mechanical cleaning system. The acrolein feed to the raw cooling water systems not having mechanical cleaning would be made once a day for 30 minutes at a rate to give an inlet concentration of 0.3 mg/l.

As with chlorine feed, blowdown from the cooling towers would be shut off during acrolein feed times and reopened after the residual had been dissipated to insignificant levels. The RCW would be remixed with the condenser cooling water before going to the cooling towers. This mixing would dilute the acrolein approximately 14 to 1, thus reducing the concentration to less than 0.03 mg/l.

3.6.2 Essential Service Water (ESW) - Essential service water will be provided for each plant by a closed-loop system employing spray ponds to dissipate the waste heat to the atmosphere. These ponds are sized to hold a sufficient supply of water for the systems so that, in the event of loss of makeup water supply, makeup would not be required to the system for safe shutdown of the reactor.

Blowdown from the ESW spray cooling ponds will be discharged via the diffuser system and mixed with the reservoir. This system is expected to be operated at a concentration of solids in the system of about twice the concentration in the reservoir, as was discussed for

the condenser cooling water system in section 3.6.1. To maintain these operating conditions, a blowdown of about 1,000 gal/min per plant will be required from the pond. This blowdown will be mixed with blowdown from the main condenser cooling water system which has a flow rate of approximately 25,000 gallons per minute.

As discussed in section 3.6.1.3, it is anticipated that biocide treatment will be required to maintain cleanliness in the ESW system and assure proper operation. Treatment is proposed to be the same as was previously described for the condenser cooling water system above. Chlorine will be fed in the form of sodium hypochlorite to achieve a residual of 0.5 ppm to the system for 60 minutes once per day. Blowdown from the system would be closed off during these periods to retain any chlorine within the system and not allow discharge to the reservoir. During this period, the concentration of solids in the system will rise slightly, but because of the relative ratio of the size of the system to the blowdown, this concentration rise will be very slow. For example, discontinuation of blowdown for 24 hours would result in the concentration increasing from 2.0 to 2.02. After chlorination has ceased and the residual reduced below acceptable limits, normal blowdown will be reinstated and the solids concentration will gradually decline toward the normal operating value. It is not expected that chlorination of this system would be done at the same time treatment is being given to the CCW systems to avoid cumulative effects.

It is expected that, in addition to the chlorine treatment, treatment for control of Asiatic clams may be required in the ESW system. As stated before, the high doses of chlorine required to control clams are not felt to be economical or desirable. As discussed above in section 3.6.1.3, acrolein appears to be the most desirable biocide to be used for clam control in the ESW system. Details of use of this agent in the ESW system will be the same as was discussed in section 3.6.1.3.

3.6.3 Filtered Water Treatment System - Each plant has a filtered water system. Raw water taken from the reservoir is treated to remove the suspended solids thus producing "filtered water" suitable for use as bearing lubricants and feed to the steam systems makeup demineralizer. The treatment plant will have a maximum capacity of 486 gallons per minute but will operate at this rate only before unit startup and at periods of unit outages which will include a period of about 12 weeks annually. Normal operation will be about 120 gallons per minute for 8 hours per day.

Normal treatment of the raw water will require the use of such chemicals as aluminum sulfate, soda ash, and chlorine. This treatment will tend to make the suspended solids coagulate forming large heavy particles which settle out of the water. This floc will contain aluminum hydroxide and suspended solids. As the concentration of these solids builds up in the bottom of the settling basin, the concentrated slurry will be pumped to a solids separation unit. The system tentatively proposed for this purpose is a tubular filter unit where the

slurry would be pumped through the filters which remove the floc and settled solids from the slurry. The solids material would then be hydraulically compressed to pack the sludge under high pressure. This compaction would result in a "cake" containing about 80 percent by weight floc and solids. The remaining 20 percent would be entrained moisture. The cake would be a solid residue suitable for disposal in an approved sanitary landfill. The filtrate would be recycled to the inlet of the water treatment plant and added to the raw makeup water for processing.

In addition to the treatment chemicals mentioned above, it may become advantageous to use a coagulation aid to improve the performance and efficiency of the filter plant. Any aid used would be selected from those approved for use by the Environmental Protection Agency and will be used in accordance with manufacturer's recommendations. Since a coagulation aid is used to improve the efficiency of the sedimentation process, its use should result in the use of less alum and soda ash.

Operation of each filter plant is expected to require the annual use of 57,526 pounds of aluminum sulfate [$Al_2(SO_4)_3$] and 20,712 pounds of soda ash (Na_2CO_3). The waste produced from the operation should amount to 26,200 pounds of aluminum hydroxide and 83,522 pounds of settled solids. Approximately 4,700,000 pounds of water will be recycled back into the makup stream.

As a result of this process, approximately 1,070 cubic feet of processed solid waste will be generated from this source. This waste will be buried either onsite or offsite in an approved landfill, observing the applicable standards.

3.6.4 Makeup Demineralizer - Filtered water will be treated by a demineralization system to supply high-purity makeup water to the steam cycle and provide high-purity water for other minor plant uses such as equipment decontamination, laboratory use, etc. The demineralizers at each plant will have a capacity of 385 gallons per minute and can run for 20 hours per day while allowing 4 hours per day for required regeneration. It is anticipated that the system would run at full capacity only before unit startup and then during annual outages each year. These outages are expected for approximately 12 weeks per year. For the other 40 weeks per year, very little makeup is expected to be required considering recycling as much water as practical from the waste systems. Based on this expected operational schedule, approximately 126,200 pounds of sulfuric acid and 103,100 pounds of sodium hydroxide will be used at each plant to regenerate the demineralizers. In addition, waste water will be generated because of the backwashing and rinsing requirements in the regeneration process. Approximately 17,000 gallons of waste will be generated each time the demineralizer is regenerated.

The total volume of regenerant wastes generated per plant is expected to amount to 2,990,000 gallons per year.

This waste water and the spent regenerants are directed through a weak cation-anion exchanger, which will neutralize the waste and discharge it to a sump where they are mixed together before being discharged to the CCW system.

With the exception of the sulfuric acid and sodium hydroxide used to regenerate the demineralizers, the other constituents present are only "natural" elements which were removed from the treated raw water and not "added" compounds. The weak cation exchanger is charged initially with a weakly acidic cation resin which has a negligible salt splitting capacity. The neutral salts washed out of the demineralizer will not consume exchange capacity in the neutralizer but will pass through without reaction. The acid and caustic will react, however, and become neutralized. Typical reactions are as follows:

Reaction with acid

$2RNa + H_2SO_4 \qquad\qquad 2RH + Na_2SO_4$

Reaction with caustic

$RH + NaOH \qquad\qquad RNa + H_2O$

This unit is self-regenerating as long as the process is in balance. The effluent will be monitored for pH to detect any "leakage" resulting from an imbalance in acid and caustic treatment.

Maximum daily discharges and average annual expected discharges are shown in table 3.6-2. Also included are the maximum concentrations expected in the cooling water blowdown discharge conduit and the maximum expected concentrations at the edge of the mixing zone in the river. Actual concentrations seen in the reservoir will be even smaller than those shown due to the small size of the mixing zone.

<u>3.6.5 Auxiliary Steam Generator System</u> - Two 100,000 pound-per-hour oil-fired steam generators will be supplied per plant at the proposed Hartsville plant to provide steam for unit startup sealing and heating requirements, building heating requirements, and other minor plant steam needs. The operation schedule of these generators cannot be determined accurately at this time. Their operation will be determined by unit outage frequencies and weather conditions.

Chemical treatment of the feedwater to these units will consist of the intermittent addition of ammonia for pH control and the continuous addition of hydrazine for scavenging dissolved oxygen in the system. The concentration of hydrazine in the feedwater will be about 10-15 μg/l, and the concentration within the system is expected to be at values below detectable limits. Blowdown from the generators will be utilized as the method for controlling the buildup of solids in the system and maintaining required water chemistry. Blowdown rates are expected to vary from 5,000 to 11,000 gallons per day for each pair of generators. It is expected that this blowdown will contain a concentration of about 0.3 mg/l of ammonia. This will result in an annual discharge from the generators of about 33 pounds of ammonia per plant.

In addition to the treatment chemicals contained in auxiliary steam generator blowdown, other impurities will be present in small quantities. These are primarily natural elements which entered the system in small quantities through the makeup and were concentrated by generation of the steam. This would not be "added" compounds. There would be some "addition" or corrosion products to the stream but these oxides primarily would be in very small concentrations.

The blowdown from the auxiliary steam generators will be discharged to the CCW system. It is expected that any residual ammonia will be scrubbed out by the CCW cooling towers such that there should be no detectable concentration of ammonia present in the CCW system which could be discharged via the CCW blowdown.

3.6.6 Closed Cooling Water System - The closed cooling water system, used to cool the components of the reactor system during reactor shutdown, forms an intermediate barrier between the radioactive cooling system and the raw service system. As currently planned, the closed cooling water system will utilize water of sufficiently high quality that inhibitors will not be necessary. Should it become necessary to use an inhibitor, an amine such as ammonia would likely be used. If ammonia were used, the concentration within the component cooling water system is expected to be equivalent to about 5 ppm ammonia. Hydrazine or a similar agent could be used as an oxygen scavenger. Concentration of hydrazine would likley be about 5-10 ppm.

When necessary for maintenance purposes, the cooling water will be drained from portions of the system. If possible, the water will be returned to the closed cooling water system. Otherwise, the water will be processed through the radwaste system for recycle or discharge.

3.6.7 Transformers and Electrical Facilities - Some oil leakage may occur from bearings and other parts of certain machinery inside buildings. The oil will be drained to an oil sump that will have adequate capacity to contain all spillage which will be recovered for reclamation or disposal.

In the event of an outside oil spill from the main stepup transformer or insulating oil storage tank, the oil spillage will be routed to the storm drains and then to the drainage pond. At the drainage pond, the oil will be recovered for reclamation or disposal.

Diesel fuel oil for auxiliary boilers and lube oil will be **stored in tanks in an area which will be diked to form a basin of sufficient capacity to retain 1.5 times the contents of the largest storage tank. During periods of rainfall, some runoff water** may accumulate in the basin. A valved low-level discharge pipe will be provided for periodic removal of precipitation collected within this area and basin contents will be inspected before discharge to assure that oil will not be released by this mechanism. The valve will be maintained in a closed position at all other times to provide for retention of oil should the tanks rupture.

In the interest of fire prevention, indoor transformer installations will be either Askarel-filled or dry-type transformers. When the former is used, the transformer will be located within a concrete basin to contain any possible spillage of this liquid. This will isolate this liquid (which contains polychlorinated biphenyls) from the common floor drainage system. Either a separate drain will be provided for routing any spillage to a separate storage sump or else the basin will be made high enough to hold the entire liquid content of the transformer. In either case, spilled liquid will subsequently be drummed for proper disposal if not suitable for reuse. Plans are to return the liquid to the manufacturer for ultimate disposal.

<u>3.6.8 Auxiliary Reactor Systems</u> - Various auxiliary reactor systems receive chemical treatment for corrosion control and other reasons. These systems are normally not used regularly in operations and are not sources of chemical discharges.

The standby liquid control system contains approximately a 12 percent concentration of sodium pentaborate used for reactor control in emergency conditions. This system normally would only be used for periodic testing. Wastes from this system would be collected in drums for disposal as nonradioactive waste. The drums will be held onsite for disposal by an environmentally suitable method.

The residual heat removal system is placed in layup using ammonia and hydrazine for pH control and dissolved oxygen scavenging to control corrosion. This system is normally drained and flushed prior to unit shutdown and refilled with reactor grade water. The drains and flushes containing the ammonia and hydrazine are pumped to radwaste for treatment in the liquid radwaste system.

References for Section 3.6

1. Stewart, R. E., Atmospheric Diffusion of Particulate Matter Released from an Elevated Continuous Source, Journal of Applied Meteorology, 7 (3):425-432, June 1968.

2. Hosler, C. L., J. Pena, and R. Pena, Determination of Salt Deposition Rates from Drift from Evaporative Cooling Towers, Department of Meteorology, The Pennsylvania State University, May 1972, 46 p.

Table 3.6-1
EXPECTED CONCENTRATIONS OF EFFLUENTS FROM
CCW COOLING TOWER BLOWDOWN

Parameter	Cumberland River Water Quality[1]	Effluent Guideline[2]	Maximum Stream Limit[3]	Natural Draft Cooling Towers CF=6.6[4, 5] Effluent Concentration	Concentration in River After Mixing	Dilution Water Required
	mg/l	mg/l	mg/l	mg/l	mg/l	gal.
Dissolved Solids	80	--	500	536	126	0
Suspended Solids	32	40	--	211	50	0
Ammonia	0.002	5.0	(0.5)	0.013	0.003	0
Fluoride	0.06	20.0	(1.0)	0.40	0.09	0
Chloride	3	--	(250)	20	4.7	0
Sulfate	25	1,400	(250)	170	42	0
Total Phosphate[6]	0.08	1.0	(0.08)	0.53	--	--
Silica	4.7	--	50[7]	31.0	7.3	0
Total Iron[6]	1.0	10.0	(0.3)	6.6	--	--
Manganese[6]	0.12	10.0	(0.05)	0.79	--	--
Copper	*	1.0	(0.02)	--	--	--
Zinc	0.02	2.0	(0.1)	0.13	0.03	0
Chromium	*	3.0	(0.05)	--	--	--
Aluminum[6]	1.6	250	(1.0)	10.6	--	--
Nickel	*	3.0	(0.1)	--	--	--
Silver	*	0.05	(0.005)	--	--	--
Sodium	3.4	--	(100)	24.5	5.9	0
Potassium[6]	1.9	6.0	(1.9)	12.5	--	--
Lead	*	0.1	(0.05)	--	--	--
Mercury	0.0006	0.005	(0.005)	0.004	0.0009	0
Barium	*	5.0	(1.0)	--	--	--
Arsenic	*	1.0	(0.01)	--	--	--
Cadmium	*	0.01	(0.01)	--	--	--
Selenium	*	0.01	(0.01)	--	--	--
Boron	*	500	(1.0)	--	--	--

1. Maximum concentrations of parameters in grab sample taken from Cordell Hull Dam tailrace (CRM 313.5) in May, July, and September 1973.
2. Established by Tennessee Water Quality Control Board, January 1973.
3. Sources of maximum stream limits are Tennessee water quality standards and (guidelines) and Water Quality Criteria.
4. CF (concentration factor): factor by which concentrations of parameters in raw river water are multiplied in heat dissipation system during 30-hour holdup of blowdown.
5. Maximum concentration factor expected during operation of plant.
6. Concentrations of these parameters in raw river water equal or exceed maximum stream limit.
7. Maximum stream limit was attained from Water Quality Criteria.

*Below detectable limits.

Table 3.6-2

Spent Regenerant Discharges
from Makeup Demineralizers

	Maximum Daily Pounds (Per 2-Unit Plant)	Average Annual Pounds (Per 2-Unit Plant)	Reservoir Conc. ppm	Maximum Daily Average Conc. in Cooling Water Blowdown ppm	Maximum Daily Average Δ Conc. in Reservoir ppm
1. Chemicals Added					
SO_4^{--}	1,410	123,600	25.0	4.80	0.480
Na^+	650	59,300	3.4	2.10	0.210
2. Minerals Removed from Treated Water					
Sodium Na^+	24	2,047	3.4	0.08	0.008
Sulfate SO_4^{--}	64	5,750	25.0	0.20	0.020
Chloride Cl^-	68	5,074	3.0	0.20	0.020
Total Dissolved Solids	351	32,000	80.0	1.20	0.120
3. Total Dissolved Solids	2,411	214,900	80.0	8.0	0.800

3.7

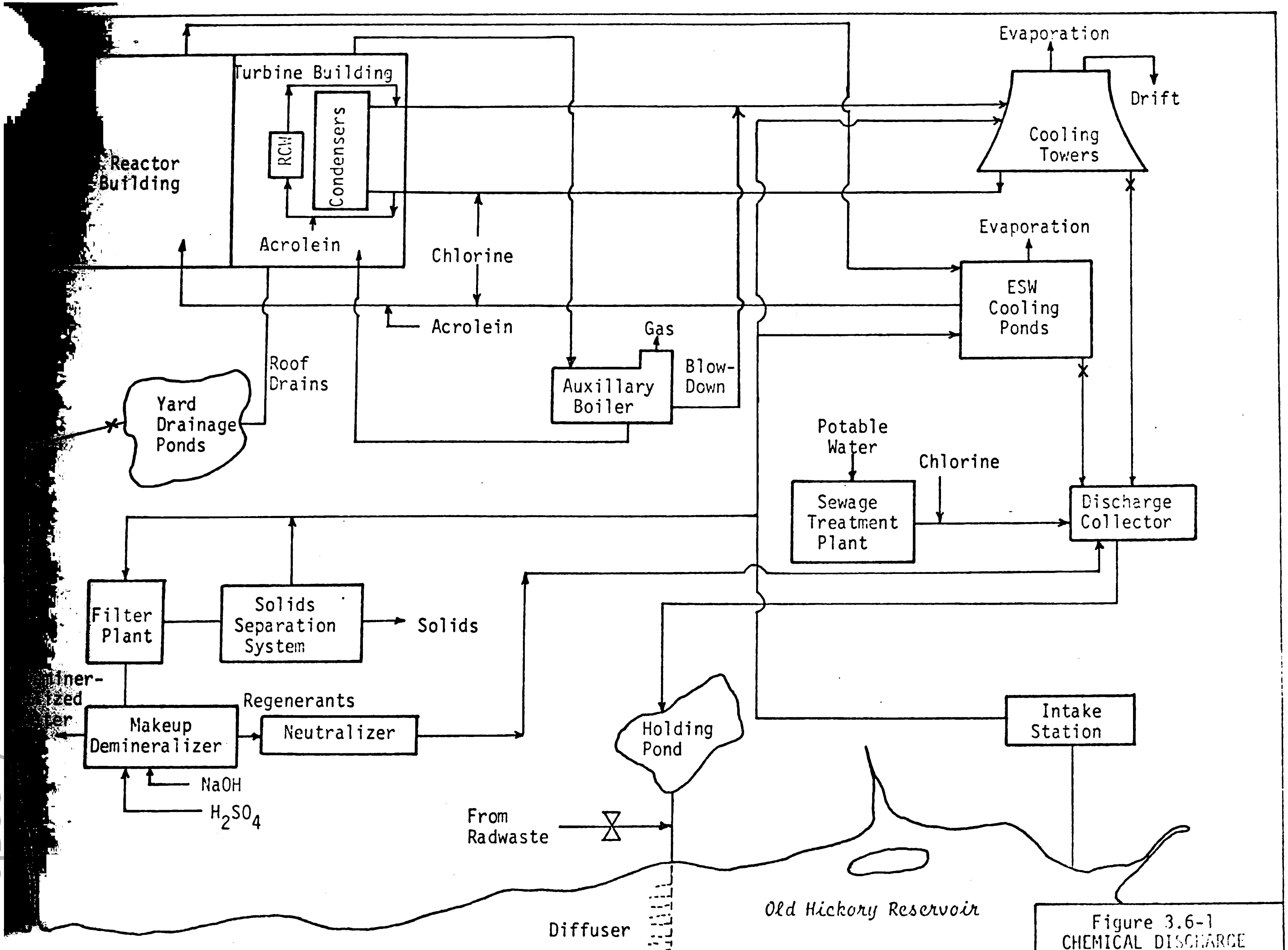

Figure 3.6-1
CHEMICAL DISCHARGE
MODEL

3.7 Sanitary and Other Wastes

3.7.1 Sanitary Waste Treatment System - The proposed systems would consist of a comminutor, a package extended aeration sewage treatment plant, and a 2,500-gallon chlorine contact tank per plant. A schematic diagram of the system is shown in Figure 3.7-1.

Plant sanitary wastes would be passed from the plant to the comminutor which reduces the particle size of the incoming wastes by cutting and shredding. From the comminutor, the wastes would enter the extended aeration package plant where they would be subjected to aerobic digestion. Effluent from the process would be collected, chlorinated, and released through the diffuser pipe.

The system would be capable of removing 90 percent of the suspended solids and 5-day BOD. The treatment facility will be designed to handle the sewage load for approximately 350 persons (12,000 GPD) per plant which should be satisfactory for the permanent employees, temporary employees, and visitors at each plant. During periods when a large temporary maintenance force is working at the plant, the permanent waste treatment system will be supplemented by portable-type chemical toilets.

Both permanent sewage systems will be operated to prevent untreated effluents from entering the river. The effluent from the treatment plant will be discharged with the cooling tower blowdown. Waste sludge will be disposed of in a manner which meets applicable regulations. The design will be in accordance with approved sanitation standards applicable to TVA facilities and the waste treatment requirements of the Tennessee Pollution Control Board.

TVA routinely sends plans of its sanitary waste treatment facilities to the appropriate state pollution control organization for their information and files.

3.7.2 Chemical Drains - Inputs to the chemical drain tank in the radwaste system will consist of laboratory drains and decontamination wastes. Some decontamination operations will involve the use of chemicals such as sodium phosphate, sodium permanganate, ammonium citrate, alkaline potassium permanganate, and nitric, citric, oxalic, acetic, and hydroflouric acids. Although the amounts of such chemicals have not been determined at this time, they will not be discharged to the reservoir but will be drained to the chemical tank.

The principal chemical reagents used in the laboratory will include sodium and ammonium hydroxides; hydrochloric, nitric, and sulfuric acids; ammonium acetate; and sodium carbonate. In addition, small quantities of various other chemicals will be used for analytical testing.

Before the chemical drain tank is emptied, its contents will be analyzed. If the liquid does not contain chemicals that would be harmful to evaporator equipment (principally chlorides and sulfides), it will be processed by the floor drain neutralizer system. The concentrates from the evaporator will be drummed and the distillate recycled, if possible. If the chemical drain tank should contain chemicals that would be harmful to the evaporator, the contents will be drummed as solid waste without further processing. The distillate will be released to the reservoir only when analysis shows that chemical and/or radioactivity levels are within acceptable limits. It is expected that release would be an infrequent event.

3.7.3 Detergent Waste System - Detergent wastes from the laundry, laboratory washings, and equipment decontamination and cleaning will be collected in the waste detergent tanks in the radwaste system. Most equipment cleaning and decontamination operations will be performed with high-pressure water and with detergent solutions. The lowest practicable amount of detergent will also be used for laundry and similar uses. These wastes will be filtered and sent to the detergent evaporator. Distillate from the evaporator is discharged to the atmosphere as a vapor and the bottoms are drummed for disposal as solid radwaste. A more detailed discussion is contained in section 3.5.1.1.3.

3.7.4 Normal Solid Waste - The nonradioactive solid waste, including sludge from the water treatment filter plant and the demineralizers, generated at the Hartsville Nuclear Plant will be disposed of in a sanitary landfill located on TVA land and operated by TVA in accordance with EPA guidelines or in a state-approved sanitary landfill on non-TVA land and operated by a municipality, county, or private contractor.

The characteristics of the nonradioactive solid waste generated at this installation will be paper, soft-drink cans, glass, wood, and garbage. The garbage portion will be relatively small in comparison to the quantity of paper present; thus, the moisture content of the solid waste will be low. The sludge from the filter plant and demineralizers will contain aluminum hydroxide which may be toxic to some plants if spread over land; therefore, the sludge will be dewatered, treated as described as in section 3.6., and disposed of in a sanitary landfill. It is estimated that the quantity

of nonradioactive solid waste will be about 30 cubic yards per week plus about an additional 60 cubic yards of sludge per year. EPA's draft guidelines permit the disposal of sludge in a sanitary landfill provided it has been dewatered. The scrap metals (other than cans) will be salvaged and sold. Scrap lumber will be salvaged for reuse and made available to scavengers when it no longer can be used by TVA. Residue from the scavenged scrap lumber will be mixed with the other solid waste for disposal in a sanitary landfill.

Solid waste handling may be available from a private contractor. Economics will determine whether TVA or a private contractor operates the collection and disposal systems. Adequate storage facilities, based on a minimum collection frequency of twice a week, will be provided and transport will be in a closed vehicle or container regardless of which method is utilized. The service provided will be continually monitored by TVA to assure conformance to applicable Federal and state regulations.

3.7.5 Gaseous Emissions - The oil-fired auxiliary steam generators will be used to supply steam for startup, building heating, and other minor plant uses. Two 100,000 pound-per-hour generators per plant are planned for this purpose. The requirements for operating these generators are dependent on unit operation schedules, weather conditions, and other factors. Therefore, an estimate of their total use is not available at this time. However, in order to estimate the maximum potential environmental impacts, it is conservatively

assumed that both generators at both plants are operated at full capacity 24 hours per day.

The generators will be fired using No. 2 fuel oil having a maximum sulfur content of 0.5 percent. At maximum capacity, it is expected that they will require approximately 1,815 gallons per hour of fuel per plant. Based on this assumption, emission rates and resultant combined pollutant concentrations were calculated.

Expected emissions of pollutants from the auxiliary steam generators at each plant are as follows:

Particulates	14.52 lb/h
Sulfur Oxides	142.58 lb/h
Carbon Monoxide	0.073 lb/h
Hydrocarbons	3.68 lb/h
Nitrogen Oxides	834.72 ton/yr

These emissions will be released through a stack the top of which is approximately 40 feet above plant grade. It is expected that the gas will exit the stack at approximately 565° F. and at a velocity of approximately 2,400 feet per minute. The stacks for the two plants are approximately 2,050 feet apart.

Because of the stack spacing, each generator was assumed to be a separate source resulting in surface concentrations not influenced by the other source. Calculated maximum ambient pollutant concentrations resulting from the above emissions, together with the applicable ambient standards, are listed below for one plant.

Pollutant	Averaging Time	Calculated Concentration	Secondary Ambient Standards
Particulates	24-hour	0.68 $\mu g/m^3$	150 $\mu g/m^3$
Sulfur Oxides	24-hour	2.60×10^{-3} ppm	0.50 ppm
Carbon Monoxide	1-hour	1.52×10^{-5} ppm	35.0 ppm
Hydrocarbons	3-hour	8.61×10^{-4} ppm	0.24 ppm
Nitrogen Oxides	1-year	2.25×10^{-4} ppm	0.05 ppm

3.7.6 Storage Tanks - The plants will be designed so that leakage, spillage, or container ruptures from any cause will not flow directly to the reservoir. Accidental releases of these liquids will either be contained in the immediate vicinity of the storage container until recovery or be routed to the yard drainage holding pond for recovery or treatment. The design of the storage facilities has not been completed at this time. However, based on preliminary designs, projected usages at Hartsville, and previous experience, expected storage facilities for these amounts of material is shown in table 3.7-1.

It is expected that there will be no release from these tanks except in the event of an accident. A detailed description of these accidents is given in section 7.3.

3.7.7 Yard Drainage Systems - Areas will be diked off to provide a yard drainage pond of approximately 15 acres for each plant. The east pond will contain a volume of approximately 230 acre-feet and the west pond will contain approximately 200 acre-feet. Locations and layouts of the ponds are shown in figure 2.1-1.

The building roof drainage system drains into the storm drainage system and thence to the yard drainage pond. The ponds will be equipped with an overflow weir with a skimmer structure which will discharge into Dixon Creek and the unnamed creek on the western portion of the site.

Any debris or oil which may be spilled in the yard will enter the yard drainage system and will flow to this pond and be

contained. The solid material will be removed as necessary from the pond and disposed of in accordance with guidelines established for the disposal of solid waste. Oil will be reclaimed for reuse when practicable. If not suitable for reuse, it will be drummed and held onsite for disposal by an environmentally suitable method. Possible disposal methods include transporting the oil to one of TVA's conventional coal-fired plants and blending it with the fossil fuels used there.

Various sumps which will not contain any hazardous or radioactive material also discharge to the yard drainage pond. These sumps would not normally handle any substances potentially detrimental to the environment. They may occasionally contain some oil which has leaked from some indoor machinery. Oil reaching the holding pool via this route will be reclaimed for disposal as described above.

TABLE 3.7-1

EXPECTED STORAGE OF HAZARDOUS MATERIALS

Material	Number of Tanks/Plant	Size	Total Storage/Plant	Expected Containment
Fuel Oil				
a. Above ground	2	175,000 gal	350,000	Dike to contain 150% volume of one tank
b. Below ground	4 2	69,000 gal 32,900 gal	276,000 65,800	Below ground in seismic category I storage
Lubricating Oil	2	30,500 gal	61,000	Dike to contain 150% volume of one tank
Insulating Oil	2	37,680 gal	75,360	Dike to contain 150% volume of one tank
	All Transformers	15,000 gal (max.)	157,000	Diked to contain 100% of volume
Ammonia	2	55 gal	110	Diked area
Hydrazine	2	55 gal	110	Diked area
Hydrogen	2	48,260 ft^3	96,500	Diked area
Caustic (50%)	1	6,000 gal	6,000	Diked area
Sulfuric Acid (66 Be^o)	1	6,000 gal	6,000	Diked area
Sodium Hypochlorite (8%)			2,626 gal	Diked area
Acrolein	4	370 lb	1,480 lb	Outside building

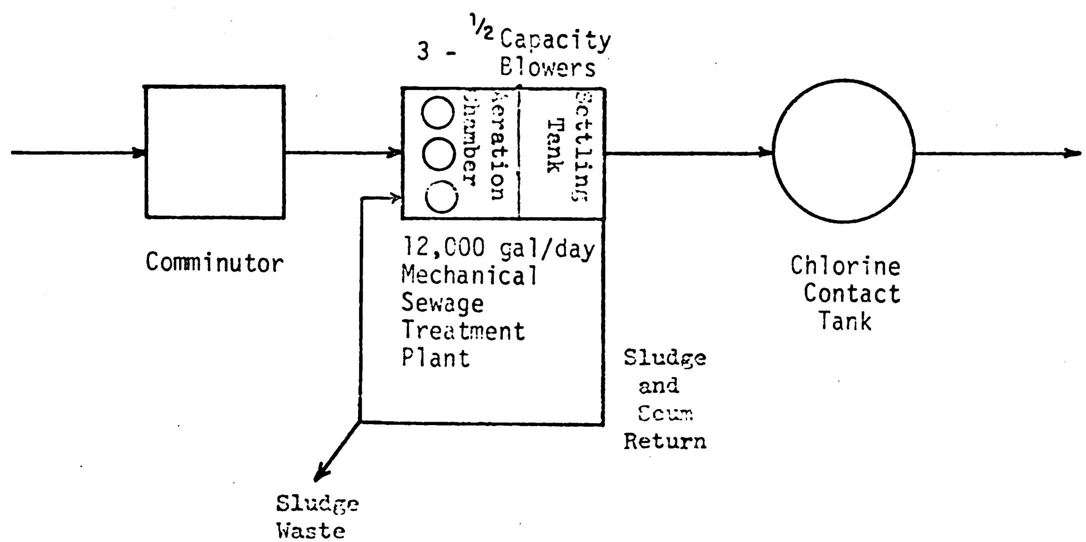

Figure 3.7-1

PACKAGE EXTENDED AERATION PLANT

3.8 Radioactive Materials Inventory

3.8.1 - New Fuel - The initial core for each unit will consist of about 138,000 kilograms of uranium contained in about 157,000 kilograms of uranium dioxide. As described in section 3.2.2, the UO_2 will be in the form of pellets which have been pressed, sintered, and ground to a diameter of approximately 1/2 inch. The pellets are stacked in a 176-inch long Zircaloy tube to a height of 148 inches. These tubes are closed and welded at both ends, forming a fuel rod. The top portion of the rod is used to accommodate the fission gases produced during irradiation of the fuel. The rods are grouped into assemblies comprising 63 fuel rods and one water rod in an 8 x 8 square array. The completed fuel assembly weight is approximately 715 pounds with a channel and 650 pounds without a channel. Total core loading will require 732 fuel assemblies for each reactor.

The initial core for each unit will contain fuel assemblies having an average enrichment of 1.97 weight percent U^{235}. Each assembly will contain four different enrichments. Selected rods in each assembly will, in addition, be blended with gadolinium burnable poison. The reload fuel will also contain four different enrichment rods and will have an average enrichment of 2.72 weight percent U^{235}.

New fuel is shipped independent of its channel. The gross loaded weight of a shipping container with two fuel assemblies is about 2,700 pounds. A shipment involving 16 containers would weigh approximately 43,200 pounds. The initial core for each unit will require approximately 23 shipments.

An annual refueling cycle will require replacing approximately 200 assemblies of each unit each year for a total of 800 assemblies per year. The reload fuel will be shipped in DOT-AEC approved shipping containers which hold two assemblies each. The fuel will most likely be shipped by truck trailers in quantities of up to 16 shipping containers per load, thus requiring about 25 shipments per year to the plant.

3.8.2 - Irradiated Fuel - Irradiated fuel will be discharged from each unit with an average rated burnup of about 24,000 MWd/MTu and maximum burnup of about 35,000 MWd/MTu. The fuel will be held approximately 3 to 4 months in the spent fuel cooling pool before shipment to allow for the decay of the short-lived fission products.

The cask for shipment of irradiated fuel has not yet been selected. The cask used will comply with all applicable AEC and DOT regulations.

There are several possible methods for shipping irradiated fuel. These range from truck shipments with cask capacities of from 2 to 6 fuel assemblies to rail shipments with cask capacities of from 18 to 32 fuel assemblies. Water transportation of spent fuel could also be used.

Truck shipments of the 800 spent fuel assemblies per year from the site would require about 400 legal weight shipments (73,280 pounds) or about 135 shipments if overweight truck loads are permitted. Rail shipments originating from the plant would require from 25 to 45 shipments annually depending upon the size of the cask used. The 18 and 32 assembly casks, when fully loaded, will weigh 168,000 pounds and 230,000 pounds respectively.

<u>3.8.3 - Radioactive Waste</u> - Radioactive waste materials to be shipped from the plant will include spent demineralizer resins, both powered and bead type, used filters, waste sludges and evaporator bottoms resulting from radwaste processing systems, and miscellaneous dry solids.

The spent powdered resins and spent bead resin will be placed in 170 ft^3 steel containers and solidified with cement. Waste sludge and waste evaporator bottoms will also be mixed and solidified in 170 ft^3 steel containers and enclosed in a shielded cask. Miscellaneous dry solids will be compacted in 55-gallon drums. Spent air filters normally will be low specific activity materials and, as such, placed in boxes or other suitable packages.

If the spent air filters are too contaminated for normal packages, they will be placed in shielded packages. All shipping packages and activity levels will conform to applicable Department of Transportation and Atomic Energy Commission regulations. Table 3.8-1 lists the types of wastes and the estimated weight, volume, and specific activity to be shipped each year from the 4-unit plant.

TABLE 3.8-1

ANNUAL QUANTITIES AND ACTIVITIES OF RADWASTE MATERIALS EXPECTED FROM 4-UNIT OPERATION*

Type of Waste	Annual Weight (lbs.)	Annual Volume (ft^3)	Expected[a] Activity (Ci/ft^3)	Raw Form
Spent powdered resin	137,100	2,200	0.48	Solid
Spent bead resin	757,700	12,800	0.07	Solid
Miscellaneous dry solids	240,000	6,000	<0.01	Solid
Air filters	1,560	96	<0.01	Solid
Waste sludge	74,500	1,200	0.06	Liquid
Waste evaporator bottoms	3,026,400	48,800	0.05	Liquid

*Based on 80-percent capacity factor.

a. Activities shown are specific activities for the particular waste and does not reflect mixing with cement.

3.9 Transmission Facilities

The proposed route corridors for the transmission line connection to the Hartsville Nuclear Plant are shown as dashed lines on **Figure** 3.9-1, and a description of these corridors is given in Section 3.9.2. Significant pivotal points along the route have been identified by alphabetical characters. By constructing multiple transmission lines along the same corridor a total of approximately 350 miles of transmission line connections to the Hartsville plant will be constructed on these 194 miles of right of way corridors of which 40 percent is forested, 58 percent is nonforest and 2 percent is water. Approximately 5,400 acres of land will be encumbered by these corridors. Approximately 450 acres will be existing right of way purchased for other projects presently under construction.

3.9.1 General Description - line design - The proposed 500-kV transmission lines will be designed to use single circuit steel towers. These self-supporting steel structures will be of a four-legged configuration using body extensions and variable length legs to provide height variations to properly fit the tower to local ground conditions. This structure which is illustrated by **Figure** 3.9-2 has a basic height to the crossarm of 84 feet, but variations in this dimension will be made to provide ground clearance as necessary to meet or exceed requirements of the National Electric Safety Code (Sixth Edition). In general, TVA design criteria utilizes the following clearances for 500-kV lines:

Open Ground	35 feet
Secondary roads	37 feet
Main highways	40 feet
Foreign transmission lines	20 feet
Railroads	45 feet

Each phase of this three-phase line will consist of three 954,000 cmil, ACSR subconductors (approximately 1.2 inches in diameter) arranged in a triangular configuration with the apex pointed downward. The subconductors will be equilaterally spaced with an 18-inch separation. A 30-foot phase separation between conductor bundles will be provided unless other special design considerations dictate variations in this dimension. Lightning protection for the line will be provided by installing two overhead ground wire cables located approximately 7 feet inside and 31 feet above the outside phase conductors. The midspan separation between the ground and phase wires will be approximately 36 feet.

At each tower location, the line will be insulated from the structure by using two 24-unit (5-3/4" x 10") suspension insulator strings per phase, forming a "V" configuration. These sky gray colored insulator units will have an ultimate strength of 25,000 pounds.

In order to minimize total land requirements for overall transmission line connections to meet system needs, four sections of the proposed 500-kV line connections will be designed to accommodate 161-kV underbuilt lines. These 161-kV connections will provide the station service emergency shutdown power to the proposed nuclear plant. Special crossarms will be provided on the 500-kV structure to support the 161-kV circuit and tower heights will be increased by approximately 30 feet to provide necessary circuit separation.

The resulting double-circuit tower configuration (see Figure 3.9-3) will extend from the approximate location of the Hartsville Nuclear Plant site to an intersection with (1) the Gallatin-Lafayette 161-kV line, located approximately 1 mile northeast of Paynes Store, and (2) the Gallatin-Cordell Hull 161-kV line, located approximately 5.5 miles south of the plant site.

Right of way corridors varying from 175 to 425 feet wide will be purchased for the proposed line connections to Hartsville Nuclear Plant. Preparatory to construction, corridors from 150 to 400 feet wide will be cleared. This clearing will be performed by the shear clearing method except in areas where this method is impractical (for example, along fence rows, ditch or stream banks, steep slopes or areas with extensive rock outcropping) or undesirable (for example, in scenic or highly visible areas).

3.9.2 Transmission line corridor descriptions - The physiographic provinces affected by development of these lines are the Nashville Basin and a portion of the Highland Rim in Middle Tennessee.

The Highland Rim land surface is level to rolling (between 600-1,200 feet elevation) and underlain predominantly by Mississippian and Devonian flatlying limestones, cherty limestones and shales. The soils are generally moderate to low in fertility in the eastern areas. About one-third of the area is in forest, mainly farm woodlands with large commercial holdings on steeper lands. The Nashville Basin, Province of Middle Tennessee is an elliptical depression in the center of the Highland Rim. Parent material is Ordovician limestone although soils of cherty limestone derivation are common near the perimeter.

Outer basin topography is gentle and soils are often deep and fertile. Inner basin sites slope less and are less fertile and drier than outer basin sites. Cedar glades, which are unique floristic elements, are located in the basin. About one-fourth of the area is in forest, nearly all in farm woodland.

The three transmission corridors will traverse approximately 5,400 acres, 2,311 acres of which is forested (Table 3.9-1). There are 1,888,800 acres of forest in the 12 Middle Tennessee counties (Cannon, Smith, Sumner, Trousdale, Wilson, Williamson, Rutherford, Maury, Franklin, Moore, Bedford, and Coffee) that the corridors traverse. The forested area involved is mostly small farm woodlands and areas along water courses where steep slopes prevent other land uses. The longest continuous forested area traversed is along the steep Highland Rim.

Timber resources were estimated using TVA permanent forest inventory plots selected for use based on their geographic and topographic locations relative to the proposed right of way. Approximately 50 percent of the rights of way fall in counties where TVA does not conduct forest inventories. TVA aerial photos were used to estimate the timber resources for this portion of the corridors. Each corridor was visually inspected from a helicopter to help identify critical aspects not visible on maps or photos. The visual reconnaissance indicated the majority of the forest cover on the right of way is pole size and small sawtimber size hardwood stands. Several stands of cedar were seen. The only coniferous stands are in the vicinity of Tullahoma, on AEDC lands.

Principal species found in this general area are listed in Table 3.9-2. Hackberry and hickory species dominate the hardwoods. Eastern Red Cedar is predominate among the conifers.

The present volume of all merchantable sawtimber trees (hardwoods, 11 inches DBH or larger and softwoods, 9 inches DBH or larger) on the 2,311 acres is estimated to be 4,848,400 bd. ft. (2,098 bd. ft. per acre). The volume of all sound trees 5 inches DBH or larger is estimated to be 1,601,500 ft^3 (693 ft^3 per acre) (see Table 3.9-3).

Productivity is estimated at 45 ft^3 of wood per acre per year or 103,995 ft^3 annually for the 2,311 forested acres. This is .19 percent of the annual productivity of the 12-county area traversed by the rights of way.

Land area classification and timber volumes for each proposed corridor are shown in Tables 3.9-4, 3.9-5, and 3.9-6.

3.9.2.1 Corridor 1 - To provide two of the proposed 500-kV line connections, the future Wilson-Montgomery 500-kV transmission line will be opened approximately 6 miles west of Gallatin, Tennessee, and looped into the Hartsville Nuclear Plant site. This will form the Wilson-Hartsville 500-kV Transmission Line and the Montgomery-Hartsville 500-kV Transmission Line. (Construction of the Wilson-Montgomery 500-kV line will be complete prior to the construction of the Hartsville Nuclear Plant connections.)

This proposed loop connection will be constructed along the route shown as Corridor 1 on Figure 3.9-1. The loop will be constructed using single-circuit, self-supporting steel towers along right of way 300 feet wide, 275 feet of which will be cleared. Approximately 9 miles of this connection in the vicinity of Hartsville will be underbuilt with 161-kV circuits.

Section A-B (11.0 miles) - Corridor 1 will leave the nuclear plant site generally westward traversing predominately wooded areas before crossing the Big Goose Creek inlet of Old Hickory Lake. This

crossing will be made on U.S. Government Reservation property and will be partially shielded by a buffer of trees on the west side of the creek. The corridor then turns northwestward crossing open pasture land before reaching the Cumberland River. From Hartsville, southward to the Cumberland River, the property adjacent to Tennessee Highway 141 is congested with residential and commercial developments. To avoid conflicting with these existing developments, a corridor south of the Coleman-Winston Bridge was therefore investigated. The resulting location will cross the tip of a peninsula where the river makes a sharp bend necessitating two river crossings. The crossings will be approximately perpendicular to the river and the corridor will traverse open land presently used for pasture. A wooded hill west of the second crossing will provide a background of trees to lessen the visibility of the proposed transmission line towers. Continuing westward across mostly open pasture land, the corridor crosses a small embayment of Old Hickory Lake approximately 1.5 miles from the river crossing. After crossing the small embayment, it was necessary to investigate a route either north or south of Gallatin. The property south of Gallatin, between Gallatin and Old Hickory Lake, has good residential and commercial development potential and was therefore avoided. Also, points for crossing four-lane U.S. Highway 31E between Gallatin and Nashville are quite limited due to existing developments. The area north of Gallatin was investigated and found to have less potential for future development. Likewise, except for in the immediate vicinity of Gallatin, there are no major existing developments along the main highways to the north. Therefore, a corridor was routed to the north of Gallatin. The corridor turns northwestward and continues across mostly pasture land as it crosses both Tennessee Highways 10 and 25 before intersecting with the Gallatin Lafayette 161-kV Transmission Line at point B.

Section B-C-D (19 miles) - At point B, the two underbuilt 161-kV circuits will be connected to the Gallatin-LaFayette 161-kV line. The two 500-kV circuits will continue generally northwestward crossing U.S. Highway 231 north of the community of Paynes Store. Continuing westward, corridor 1 traverses open pasture land as it passes approximately 1.5 miles north of Castalian Springs. The corridor then crosses U.S. Highway 31E in a low lying area along Deshea Creek, northeast of the city of Gallatin. The corridor continues westward following Deshea Creek for about one mile before traversing higher ground as the corridor swings north of Gallatin. As the corridor approaches Tennessee Highway 25, the route turns southwestward and intersects with the Wilson-Montgomery 500-kV Transmission Line at point D. At this intersection, both lines from Hartsville will be looped into the Wilson-Montgomery 500-kV line, thereby connecting the Hartsville Nuclear Plant to the Wilson and Montgomery 500-kV Substations. The last 11 miles of the corridor cross through open pasture land and hilly wooded terrain with little or no development.

3.9.2.2 Corridor 2 - This proposed transmission line corridor shown on Figure 3.9-1 will be approximately 86 miles in length and will vary in width from 175 feet to 325 feet. The 175-foot-wide section will be occupied by one 500-kV transmission line with a 6-mile section from Hartsville (point A) to point F being underbuilt with a 161-kV transmission line. Approximately 12 miles of 200-foot-wide right of way east of Shelbyville which was purchased for the Maury-Franklin 500-kV Transmission Line project will also be utilized for the Hartsville-Franklin 500-kV line connection. An additional 100 feet of right of way

will be required to accommodate these two circuits. A 9-mile section (I-J) of 325-foot right of way in the vicinity of Tullahoma is existing right of way that was purchased earlier for a needed 161-kV transmission line and in anticipation of future 500-kV connections into the Franklin 500-kV Substation.

Section A-F (6.0 miles) - Corridor 2 exits the Hartsville site southeastward for a span or two and crosses Dixon Creek Embayment before turning southward. The corridor crosses the Cumberland River at approximately river mile 285.9 and then parallels the river for approximately 4.0 miles. A buffer of existing trees along the west bank of the river will shield the transmission line from the river. The corridor intersects the Gallatin-Cordell Hull 161-kV line at point F, and the 161-kV underbuilt circuit will connect to the Gallatin-Cordell Hull 161-kV line at this point.

Section F-G-H (58 miles) - Corridor 2 containing one 500-kV circuit will continue southward crossing open pasture land as it approaches and crosses U.S. Highway 70N. The crossing will be approximately perpendicular to the highway. The corridor continues southward, traversing more open land used for pasture and crosses Tennessee Highway 141 in a low area where the highway parallels Jennings Fork Creek. This crossing will be approximately 4 miles east of the community of Tuckers Crossroads. The next major obstacle to be crossed is Interstate Highway 40. A point for crossing the interstate was selected in the low-lying area of Round Lick Creek. A curve in the interstate highway at the point of crossing will reduce the visual exposure of the line to the traveling public. Continuing southward through alternately wooded and open areas, the corridor crosses

U.S. Highway 70 east of Watertown. The next 51 miles of corridor traverses terrain characterized by the rugged western rim of the Cumberland Plateau and is therefore not as likely to develop in the near future. The area is presently sparsely populated with practically no commercial development except in the vicinity of small rural communities. This section of corridor crosses three main highways in its 51-mile length, Tennessee Highway 96 west of Auburntown, U.S. Highway 70S east of Readyville, and U.S. Highway 41 southeast of Beech Grove. The corridor then crosses Interstate 24 at a point where the interstate cuts through a ridge. The corridor will follow the lower slopes of this ridge which will serve as a shield to reduce the visual exposure of the line as seen from the interstate. The corridor continues to point H crossing mostly open pasture land interspersed with small patches of woodland.

<u>Section H-I (12.5 miles)</u> - At point H, the corridor intersects with a 200-foot right of way portions of which were previously purchased for the Maury-Franklin 500-kV line. To construct the proposed 500-kV connection to the Hartsville Nuclear Plant the corridor will be expanded an additional 100 feet. Impacts associated with the entire 300-foot corridor are described in this report. The land traversed by this section of corridor is mostly wooded with very little development. This section of Corridor 2 crosses the Duck River and three main roads, U.S. Highway 41A, Tennessee Highway 130, and Tennessee Highway 55.

<u>Section I-J (9.0 miles)</u> - At point I, Corridor 2 will intersect with an existing 161-kV transmission line constructed along a 150-foot corridor. Corridor 2 will turn eastward, parallel to the existing corridor to the proposed Franklin 500-kV substation site. To provide room for the proposed

500-kV line, the existing 161-kV line, and a future line connection, the existing 161-kV circuit will be retired and rebuilt as an underbuilt circuit on the proposed Hartsville-Franklin 500-kV transmission line.

The proposed corridor traverses U.S. 41 through a low-lying area where the highway parallels the L&N Railroad. The corridor terminates within the Arnold Engineering Development Center and Tennessee Wildlife Resources Agency Wildlife Management area. The line construction and revegetation plans for the portion of the corridor within the management area will be reviewed with both parties. Construction activities will be planned to minimize potential impacts as much as possible.

3.9.2.3 Corridor 3 - This proposed transmission line corridor shown on Figure 3.9-1 will be approximately 78 miles in length and will vary in width from 175 feet to 425 feet. A total of three 500-kV connections and one 161-kV connection will utilize portions of the corridor. A brief discussion of these line connections is given below.

The existing Bull Run-Wilson 500-kV Transmission Line which is located about 16 miles south of the proposed nuclear plant will be opened, and two sections of line, each approximately 16 miles in length, will be constructed to the Hartsville Nuclear Plant switchyard. This will provide electrical connections from Hartsville to both Wilson and Bull Run 500-kV Substations. The third 500-kV connection will be provided by constructing a new line from the nuclear plant to the Maury 500-kV Substation. This connection will be approximately 78 miles long.

The existing Gallatin-Cordell Hull 161-kV Transmission Line which is also located south of the nuclear plant will be connected into the plant switchyard. This 6-mile circuit will be constructed as an

underbuilt circuit common with one of the 500-kV lines along corridor 3.

The last 31 miles (Section N-S) of corridor 3 will utilize existing right of way 75 feet wide. To accommodate the proposed 500-kV connection, an additional 100 feet of right of way will be purchased for this section.

Section A-L (6.0 miles) - Transmission line corridor 3 exits the Hartsville site westward for a span or two before turning southward and crossing the Cumberland River at river mile 284. Continuing southward, this corridor crosses mostly open fields before intersecting with the Gallatin-Cordell Hull 161-kV line at point L. At point L, the 161-kV underbuilt transmission line will be connected to the Gallatin-Cordell Hull 161-kV line.

Section L-M (10 miles) - The three 500-kV circuits continue generally southward crossing U.S. Highway 70N approximately 8 miles northeast of Lebanon. Trees along the west side of the corridor crossing will provide a visual shield of the lines when approached from Lebanon and will provide a background for the towers when traveling toward Lebanon. The corridor continues southward and crosses Tennessee Highway 141 east of Tuckers Crossroads before crossing Interstate Highway 40 in the vicinity of Jennings Creek. After crossing the interstate, the corridor will continue southward approximately paralleling Jennings Creek to point M. At this point, two of the 500-kV circuits will be tied into the Wilson-Roane 500-kV line, thereby connecting Hartsville to both the Wilson 500-kV Substation and the Roane 500-kV Substation.

Section M-H (30 miles) - From point M to the Maury 500-kV Substation site, the right of way width will be reduced to 175 feet, and

the remaining 500-kV line will continue toward the Maury 500-kV Substation. Proceeding from point M, the corridor turns southwest and traverses partially wooded and open pasture land before crossing Tennessee Highway 26 at a point 2.5 miles west of the city limits of Watertown. The corridor then swings westward and passes southeast of the Cedars of Lebanon State Park. This section of the route was carefully selected to ensure that the proposed corridor does not conflict, visually or otherwise, with the park. The most outstanding natural vegetation community in this area is the cedar glades. Clearing and construction of the transmission line will be closely coordinated with appropriate divisions within TVA to ensure that any cedar glades located within the area are avoided where practical. The corridor continues in a southwest direction and crosses Tennessee Highway 10 north of the community of Walterhill. Turning more to the south, the corridor crosses through open pasture land and partially wooded terrain and will be carefully located to avoid the residential developments of Murfreesboro. The corridor crosses both old and new U.S. Highway 41-70S approximately 3.5 miles northwest of Murfreesboro. Commercial and residential developments limit the number of satisfactory corridor locations; however, the line location has been selected to avoid conflicts with these existing developments. The corridor will not impact the Stones River National Military Park which is located on old U.S. Highway 41-70S approximately 2.0 miles southeast of the proposed crossing. Continuing to the southwest, the corridor crosses I-24 at an approximate 90° angle through open land. The corridor continues another 4.0 miles around the west side of Murfreesboro before intersecting with an existing TVA transmission line right of way at point N.

<u>Section N-S (31 miles)</u> - From point N, the corridor will follow the existing right of way which will be increased in width from 75 feet to 175 feet to accommodate the 500-kV line. The corridor will extend in a southwest direction through hilly wooded areas and cross Tennessee Highway 16 as the corridor approaches the Harpeth River. Portions of the Harpeth River from the Williamson-Rutherford County line to the Cumberland River have been nominated to the Tennessee System of Scenic Rivers. The crossing of the Harpeth River will be upstream from the designated scenic river section. In addition, the transmission line towers will be carefully located so that potential impacts to the river will be minimal (see Section 2.3.2.3 Natural Significance). The corridor continues southwestward and crosses U.S. Highway 31A south of the community of College Grove. For the next 12.0 miles, the corridor traverses partially wooded hilly terrain with little development of any type until reaching Interstate 65. The corridor will cross the interstate at approximately 90°, and existing trees on each side of the interstate will provide a visual shield of the corridor from interstate traffic. The corridor extends another 9.0 miles to the Maury 500-kV Substation which is located approximately 5.0 miles north of the city of Columbia. This 9.0-mile section of the corridor crosses mostly open pasture land and will cross only one main highway, U.S. Highway 31. The crossing of U.S. Highway 31 will be at a low point in the highway, and the line will be shielded from view by rolling hills on each side of the highway.

Table 3.9-1

Major Area Classification: Proposed Routes[1]

Class	Hartsville-Maury Acres	Hartsville-Maury Percent of RoW[2]	Hartsville-Maury Percent of Class	Hartsville-Franklin Acres	Hartsville-Franklin Percent of RoW	Hartsville-Franklin Percent of Class	Hartsville-Montgomery Acres	Hartsville-Montgomery Percent of RoW	Hartsville-Montgomery Percent of Class	Total Acres	Total Percent Class
Forest	938	44.0		1159	52.4		214	19.2		2311	
			40.6			50.2			9.2		100
Non-Forest	1177	55.2		1044	47.2		893	80.2		3114	
			37.8			33.5			28.7		100
Water	17	.8		9	.4		7	.6		33	
			51.5			27.3			21.2		100
Total	2132	100	----	2212	100	----	1114	100	----	5458	

1. Based on aerial photo interpretation and 7-1/2' topographic maps

2. RoW = Right of Way

Table 3.9-2

Principal Tree Species in the Vicinity of the Proposed Power Line Right of Way

Species		Percent Distribution based on number of trees	Percent Distribution based on net cubic foot volume
Eastern Red Cedar	*Juniperus virginiana*	20.6	10.5
Black Oak	*Quercus velutina*	.5	2.2
Southern Red Oak	*Q. falcata*	6.9	5.7
Blackjack Oak	*Q. marilandica*	1.0	.6
Scarlet Oak	*Q. coccinea*	.8	1.7
Chestnut Oak	*Q. prinus*	.8	1.7
Pont Oak	*Q. stellata*	2.5	1.7
Basswood	*Tilia americana*	.8	6.4
Blackgum	*Nyssa sylvatica*	.3	.6
Yellow-Poplar	*Liriodendron tulipifera*	2.0	11.7
Box Elder	*Acer negundo*	.5	1.1
Ash spp.	*Fraxinus spp.*	1.8	2.8
Black Cherry	*Prunus serotina*	1.0	1.1
Elm spp.	*Ulmus spp.*	6.9	8.6
Hickory spp.	*Carya spp.*	22.6	15.9
Hard Maple	*Acer saccharum*	1.3	4.1
Persimmon	*Diospyros virginiana*	.4	.8
Black Walnut	*Juglans nigra*	4.2	4.1
Hackberry	*Celtia occidentalia*	15.3	11.8
Black locust	*Robinia pseudoacacia*	6.2	4.7
Honey locust	*Gleditsia triacanthos*	.3	.7
Osage orange	*Maclura pomifera*	1.3	.4
Sassafras	*Sassafras albidum*	2.0	1.1

TABLE 3.9-3

Cubic and Board Foot Volume of All Merchantable Trees in the Proposed Right of Way

	Cubic feet	Board feet
Coniferous	159,228	239,420
Hardwood	1,442,526	4,608,827
All species	1,601,754	4,848,247
Average volume per acre	693.1	2097.9

TABLE 3.9-4

Hartsville-Maury Corridor: Land Classification

Major Area Class	Acres	Percent
Forest	938	44.0
Non-forest	1,177	55.2
Water	17	0.8
Total	2,132	100.0

Cubic and Board Foot Volume of all Merchantable Trees in the Hartsville-Maury Right of Way

	Cubic Feet	Board Feet
Coniferous	64,646	97,204
Hardwood	585,666	1,871,184
All species	650,312	1,968,388

TABLE 3.9-5

Hartsville-Franklin Corridor: Land Classification

Major Area Class	Acres	Percent
Forest	1159	52.4
Non-forest	1044	47.2
Water	9	0.4
Total	2212	100.0

Cubic and Board Foot Volume of All Merchantable Trees
in the Hartsville-Franklin Right of Way

	Cubic Feet	Board Feet
Coniferous	79,933	120,189
Hardwood	724,148	2,313,631
All species	804,081	2,433,820

TABLE 3.9-6

Hartsville-Montgomery Corridor: Land Classification

Major Area Class	Acres	Percent
Forest	214	19.2
Non-forest	893	80.2
Water	7	0.6
Total	1,114	100.0

Cubic and Board Foot Volume of All Merchantable Trees in the Hartsville-Montgomery Right of Way

	Cubic Feet	Board Feet
Coniferous	14,649	22,027
Hardwood	132,712	424,012
All species	147,361	446,039

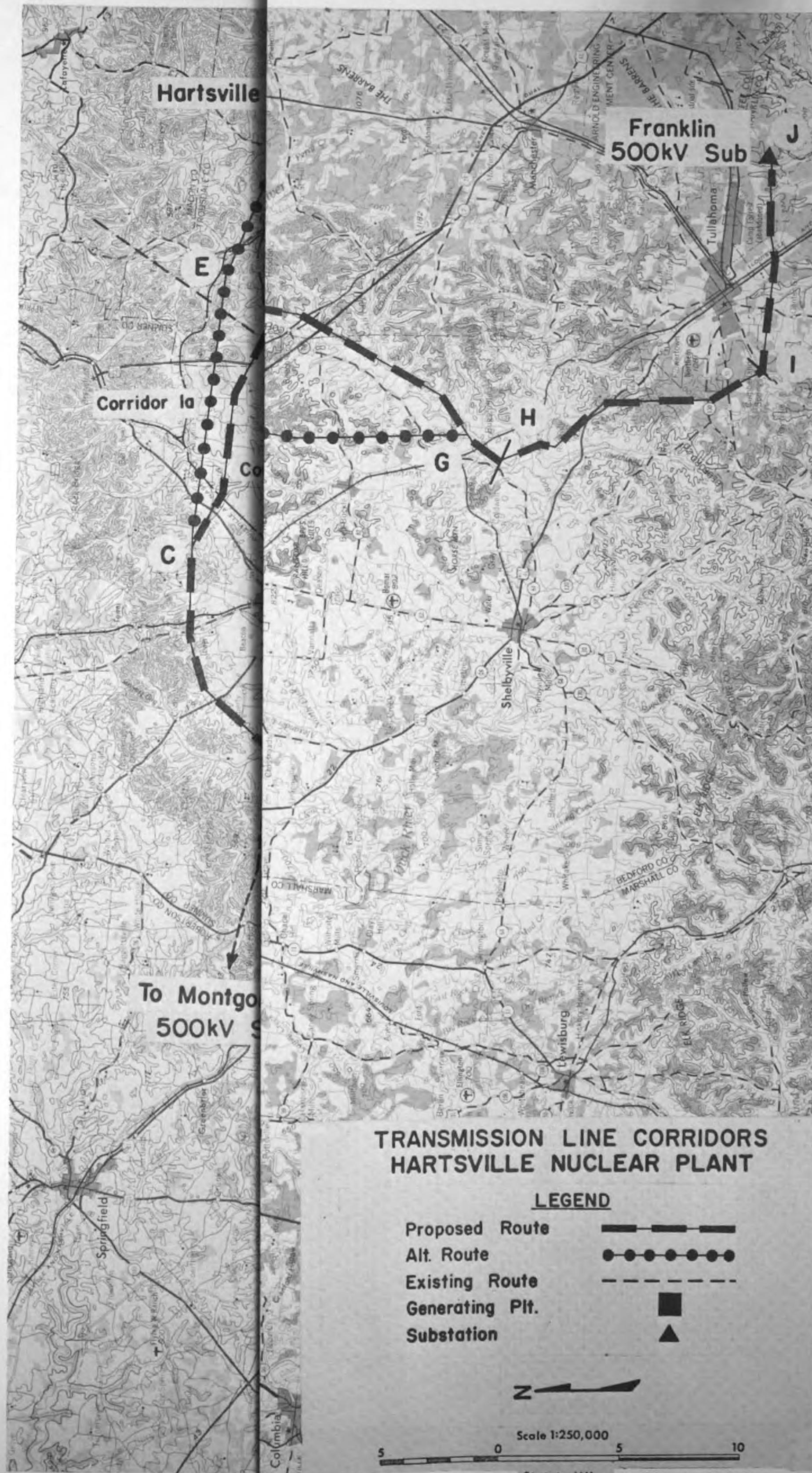
Hartsville
Franklin
500kV Sub
J
E
Corridor Ia
H
I
G
C
To Montgo
500kV S
Tullahoma
Manchester
Shelbyville
Lewisburg
Springfield
Columbia
BEDFORD CO
MARSHALL CO
ELK RIDGE
TRANSMISSION LINE CORRIDORS
HARTSVILLE NUCLEAR PLANT
LEGEND
Proposed Route
Alt. Route
Existing Route
Generating Plt.
Substation
N
Scale 1:250,000
5
0
5
10
Statute Miles

Figure 3.9-1

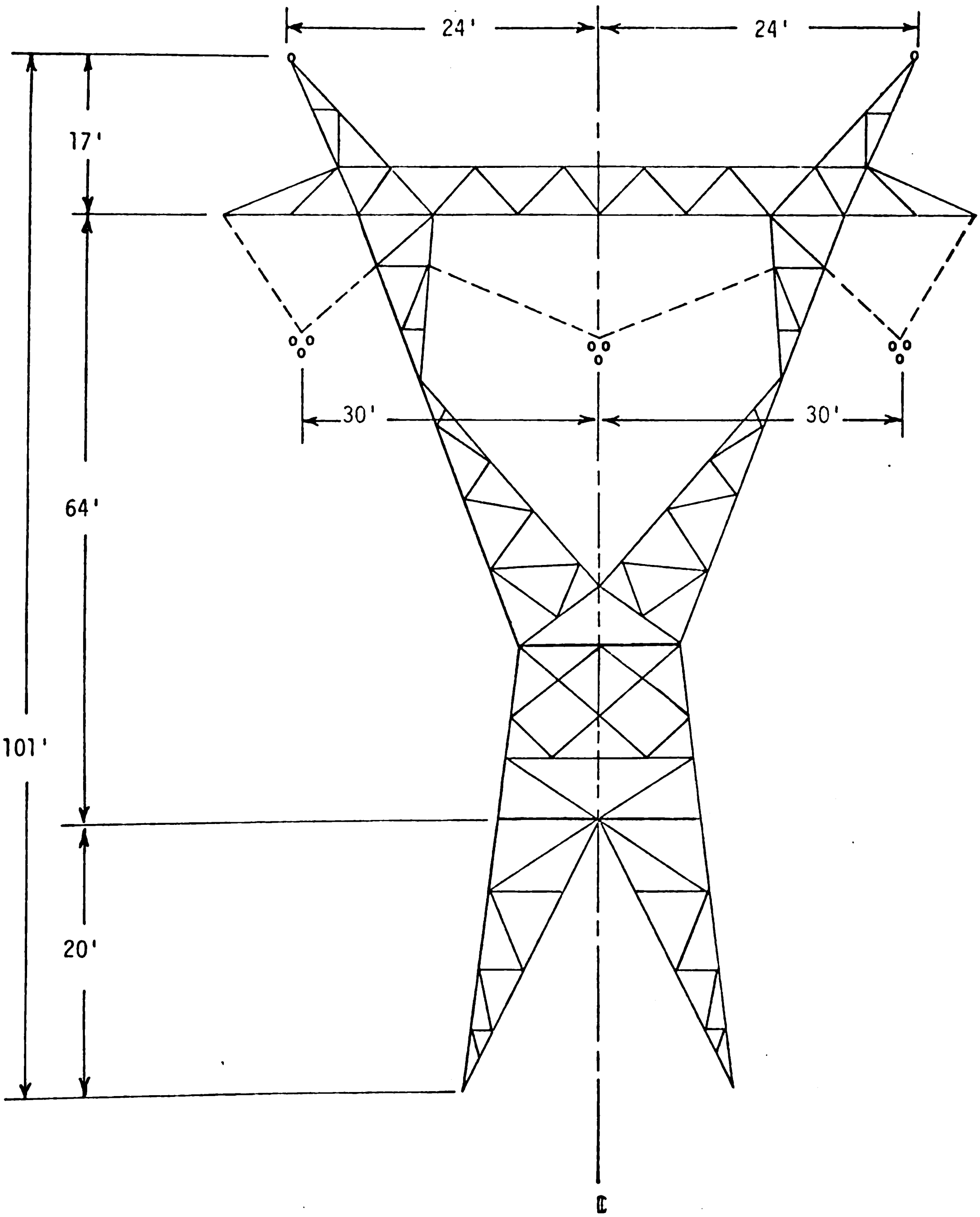

Figure 3.9-2

STANDARD SINGLE CIRCUIT
500kV TVA TOWER DESIGN

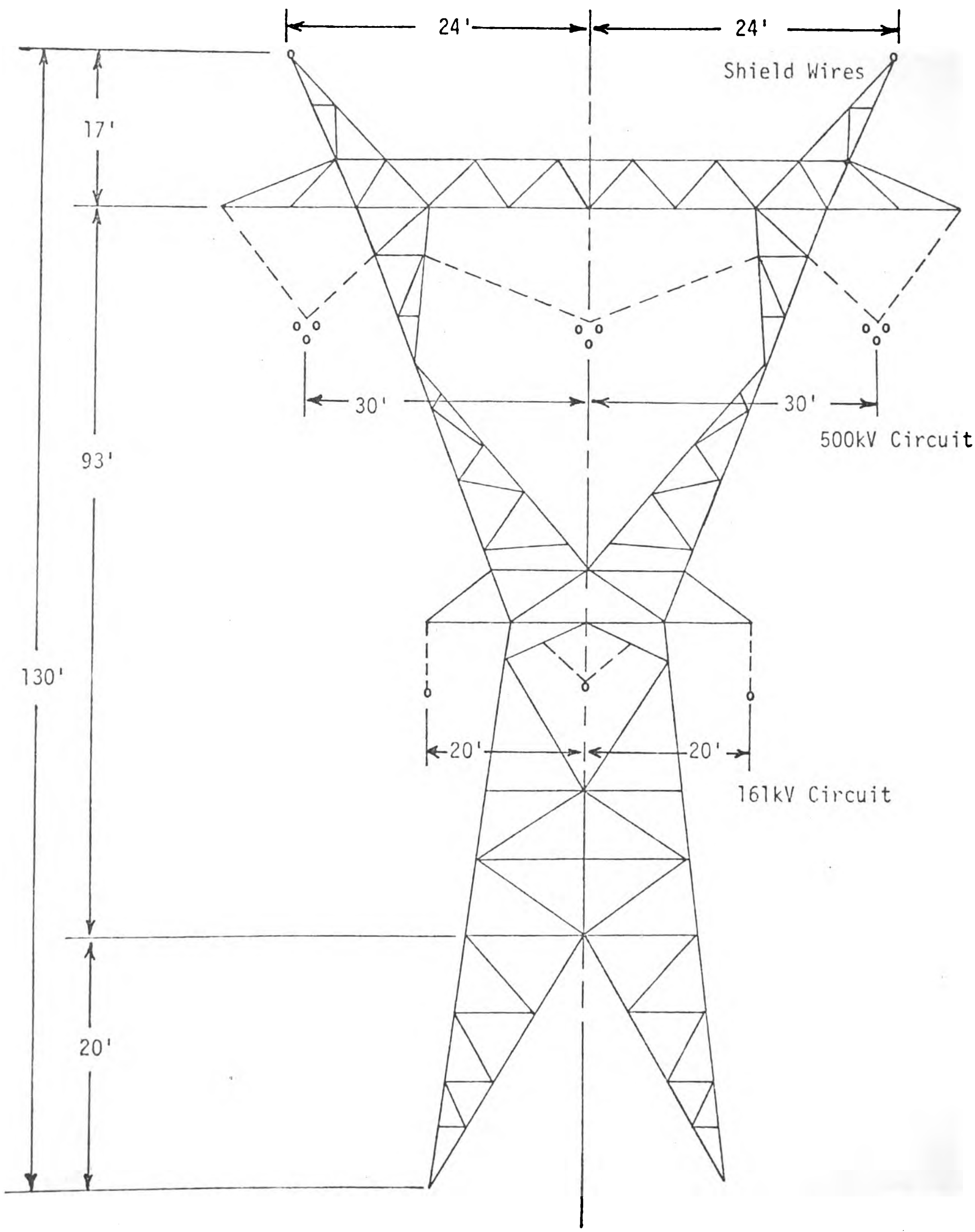

Figure 3.9-3

STANDARD DOUBLE CIRCUIT 500/161kV TOWER DESIGN